RISTCON 2020

Proceedings of
7th Ruhuna International Science and Technology Conference

January 22, 2020

Conference Advisory Board

Editorial Note

Thanks to all the contributors, we received high number of abstracts in diverse disciplines for RISTCON-2020. All of them were initially screened by the editorial board for novelty and plagiarism. Then each abstract was sent to two experts in the relevant field, serving in different universities/research institutes, for a double blind review. In cases where the decisions by the two reviewers were remarkably different, the abstract was sent to a third reviewer. Final decision was taken by the Editorial board by considering the decisions as well as comments made by all reviewers. We believe that, this process has ensured a high standard of the publication through a quality and unbiased review.

However, the responsibility for the content and the message of each publication remains with the respective authors. No part of this serial publication will be reproduced by any form. When citing the abstracts published, this serial publication can be referred as 'Proceedings of the 7th Ruhuna International Science and Technology conference, Faculty of Science, University of Ruhuna, Matara, Sri Lanka'.

Editors
RISTCON 2020

Editors

Organizing Committee

Chairperson　　　　Dr. Nadeesha M. Wickramage
　　　　　　　　　　Department of Physics, University of Ruhuna

Joint Secretaries　　Dr. W.G. Shirani Manel Kumari
　　　　　　　　　　Department of Botany, University of Ruhuna

　　　　　　　　　　Dr. Nishantha K. Kalutharage
　　　　　　　　　　Department of Chemistry, University of Ruhuna

Committee Members　Dr. W.A.H.P. Guruge
　　　　　　　　　　Department of Zoology, University of Ruhuna

　　　　　　　　　　Dr. Harshi C. Manawadu
　　　　　　　　　　Department of Chemistry, University of Ruhuna

　　　　　　　　　　Dr. K.A.S. Kodikara
　　　　　　　　　　Department of Botany, University of Ruhuna

　　　　　　　　　　Dr. K.V.S. Prasadh
　　　　　　　　　　Department of Physics, University of Ruhuna

　　　　　　　　　　Dr. M.C.S. Fernando
　　　　　　　　　　Department of Mathematics, University of Ruhuna

　　　　　　　　　　Dr. M.K.S. Madushika
　　　　　　　　　　Department of Computer Science, University of Ruhuna

Cover design:
Mr. Ranil Wickramarathne, *Department of Computer Science, University of Ruhuna*

Web developer:
Mrs. Nilani De Silva, *Department of Computer Science, University of Ruhuna*

Message from the Vice Chancellor, University of Ruhuna

It gives me great pleasure to send this message to the 7th Ruhuna International Science and Technolgy Conference of the Faculty of Science under the theme "Sustainability through advances in science and technology".

The world is changing rapidly at a higher pace than ever before. The world has gone through industrial revolution, information and computer revolution, communication and management revolution. Currently we are going through technological revolution. The world will continue to advance through scientific research and technology.

These advances are challenged by environment changes which were unknown to us but predicted by some Scientists long time back at the times of scientific discoveries by those who looked at these advances analytically. However, world went on these paths giving insignificant attention to these predictions and are now facing the challenges at a cost. The current crisis before us is to manage advances in science and technology in a green environment minimizing the damages to future generations. Australian bush fires, floods in many areas hitherto unknown to have floods, global warming, and carbon emission have become hot topics in this context.

I believe the conference will discuss these challenges under the sustainability aspect of the advances of science and technology. It is said that " Best way to predict the future is to create it". I do hope that some light would be shed on this aspect of creating the future we need to sustain the future generations for the mankind to survive for millennia to come. Once Albert Einstein has said that "I do not know what the World War III would be fought with but I do know that the Fourth World War would be fought with sticks". That is a prediction of the destruction world will face if we do not manage advances in science and technology better to benefit the humanity. In this background the theme is noteworthy.

Let me congratulate the Dean Faculty of Science, Organizing committee and all who contributed to make RISTOCON 2020 a success and wish the conference all the very best.

Senior Professor Sujeewa Amarasena
The Vice Chancellor
University of Ruhuna

Message from the Dean, Faculty of Science, University of Ruhuna

It is indeed a great pleasure for me to provide a message as the Dean of the Faculty of Science of the University of Ruhuna for 7th Ruhuna International Science and Technology Conference (RISTCON-2020). RISTCON has been providing platform for discussing findings of researchers, practitioners and educators from various scientific fields such as biological science, physical science, medical science, environmental science and technological and engineering fields for several years. I am happy to learn that RISTCON-2020 has received around 205 submissions and many of them will be presented as poster or oral presentations. I would like to thank all the authors who submitted their findings to RISTCON-2020 for their efforts in research work and willingness to share their findings among the contributors and the participants of the conference.

It is evident that our country requires collaborative efforts and contributions of researchers, policy makers, governing bodies and citizens for enhancing and developing the socio-economic status of the country. There are many areas we must consider in order to develop our country so that every person in the society enjoys a high standard of living. At this venture of our country where the people are seeking for a significant change in standards of the life, the researchers have an obligation of coming up with suitable ways specific to the country to achieve that target by disseminating useful knowledge and methods among the society with the aim of the development of the country. We should pay our attention to areas such as the fisheries industry which is presently not properly using resources around our country, management of inland water resources so that the every single drop of water is used before flowing to sea, use of solar power and wind power, value addition on raw minerals and agrarian products for exporting them, making our highly recognized health system a patient friendly system, and reducing time wastage of workforce due to inefficient public and private transport system - in fact there are many areas to be mentioned.

Organizing a conference is a very difficult and responsible task and therefore I would like to convey the gratitude of the Faculty of Science of the University of Ruhuna to Dr. Nadeesha M. Wickramage, the Chairperson of the Organizing Committee of RISTCON-2020, and her team for their creative, effective and untiring efforts for making this conference a reality.

I hope and wish all the presenters and participants would enjoy the humanity and the hospitality of our community at the Faculty of Science of the University of Ruhuna.

Professor P. A. Jayantha
Dean and Professor of Mathematics
Faculty of Science, University of Ruhuna

Message from the Chairperson - RISTCON 2020

It is with great pleasure and honour that I write this message as the Chairperson of the Organizing Committee of 7th Ruhuna International Science and Technology Conference - RISTCON 2020. First and foremost, I welcome all invitees, presenters and participants who join with us at RISTCON 2020 to University of Ruhuna. RISTCON is an excellent forum to share research findings on wide range of areas related to Science and Technology while opening doors for research interactions among peers across many disciplines.

RISTCON 2020 is organized under the theme "Sustainability through advancement in science and technology". I am pleased that this year proceedings contain 79 oral presentations and 71 poster presentations from academics and researchers from various organizations in Sri Lanka. All abstracts published in the proceedings - RISTCON 2020 are peer-reviewed by national and international experts in their respective fields. A six-member Editorial Board has assessed all abstracts for novelty, plagiarism and language to maintain the high standard of the publication. Their untiring effort and commitment are respectfully appreciated. We are sincerely thankful to all authors for their research submissions and to all reviewers for their immense contribution during the review process in making RISTCON 2020 a successful event. Moreover, the conference is enriched with a keynote speech and an invited speech. I extend my sincere appreciation to the keynote speaker Professor Ruey-an Doong and the invited speaker Professor K.M. Nalin de Silva for accepting our invitation to share their knowledge and expertise with the audience of RISTCON 2020.

I convey my sincere gratitude to the Vice-Chancellor of the University of Ruhuna, Senior Professor Sujeewa Amarasena and the Dean of the Faculty of Science Professor P.A. Jayantha, for their encouragement, guidance and support provided in making RISTCON 2020 a reality. I express my deep appreciation to the two Joint Secretaries, the Advisory Board and the rest of the Organizing Committee for their hard work and dedication. Our special thanks go to the sponsors for their generous financial contributions. I trust that you find the conference proceedings a valuable, educational and pleasurable experiences as well as you enjoy the unique architectural and natural beauty of the University of Ruhuna.

Dr. Nadeesha M. Wickramage
Chairperson
Organizing Committee of RISTCON 2020

Faculty of Science
University of Ruhuna

R STCON
2020

CONTENTS

Faculty of Science
University of Ruhuna

R STCON
2020

Abstracts of oral presentations: Session B

Faculty of Science
University of Ruhuna

R STCON
2020

Abstracts of oral presentations: Session C

Abstracts of poster presentations: Session A

Faculty of Science
University of Ruhuna

R STCON
2020

Abstracts of poster presentations: Session D

Faculty of Science
University of Ruhuna

R STCON
2020

Details of the Sessions

Session A: Agriculture, Botany and Molecular Biology & Biotechnology

Session B: Chemistry, Biochemistry, Biophysics, Ecology, Environmental Science and Oceanography

Session C: Zoology, Fisheries & Aquaculture, Medical & Health Sciences and Veterinary Science

Session D: Engineering, Physics, Mathematics & Statistics, Computer Science & ICT and Nano Technology

Keynote Speech

Nanomaterials as a green multifunctional material for water purification and energy applications

Prof. Ruey-an Doong

Institute of Analytical and Environmental Sciences, National Tsing Hua University, Taiwan

Introduction

Nanomaterials are novel materials which can not only serve as a photoelectrochhemical catalyst but also as an electrode material because of their suitable band gap, high surface area. Two-dimensional (2D) materials such as graphene family and mesoporous carbon nitride (C_3N_4) have recently attracted considerable interest because of high surface area, appropriate chemical anchoring sites, large pore size/volume, good electrical conductivity, and thermal stability [1-4]. Among these materials, graphitic carbon nitride (g-C_3N_4), an organic polymeric semiconductor mainly consisting of carbon and nitrogen with a band gap of 2.7 eV, exhibits high thermal and chemical stability, excellent electron transfer ability, and easy recycling, and has been commonly used as a photocatalyst for the effective decomposition of various hazardous chemicals. Furthermore, g-C_3N_4 has been successfully utilized as a support to disperse and stabilize metal nanoparticles such as Pd, Pt, Cu, and Co. Basically, g-C_3N_4 is formed by the linkage of N bridged tri-s-triazine repeating unit, which is generated by two-dimensional conjugated planes packed together via van der Waals interactions. In view of its unique structure and preponderance, g-C_3N_4 has been widely employed in a wide variety of fields such as oxygen reduction reaction, photocatalysis, photoelectrochemical reaction, and sensor.

For heterogeneous (photo) catalytic processes, organic compounds and metal derivatives could bind or intercalate into the matrix of g-C_3N_4 through the surface anchoring sites to improve the (photo) catalytic reaction rate, and thus broaden the (photoelectro) catalytic application of g-C_3N_4 toward organic decomposition. The unique architecture of g-C_3N_4 and the outstanding (photo) catalytic performance of metal and metal oxide nanoparticles such as Au, CeO_2, and graphene quantum dots (GQDs) provide a great impetus to use g-C_3N_4 as a promising support to judiciously decorate metal/metal oxide for the formation of highly active and green heterogeneous (photo) catalyst. Herein, we report the facile synthesis of mesoporous carbon nitride with ordered, uniform channel morphology and their use as a photocatalyst to decompose pharmaceuticals as well as a support for metal/metal oxide nanoparticles to catalytically reduce nitroarenes as well as for energy storage.
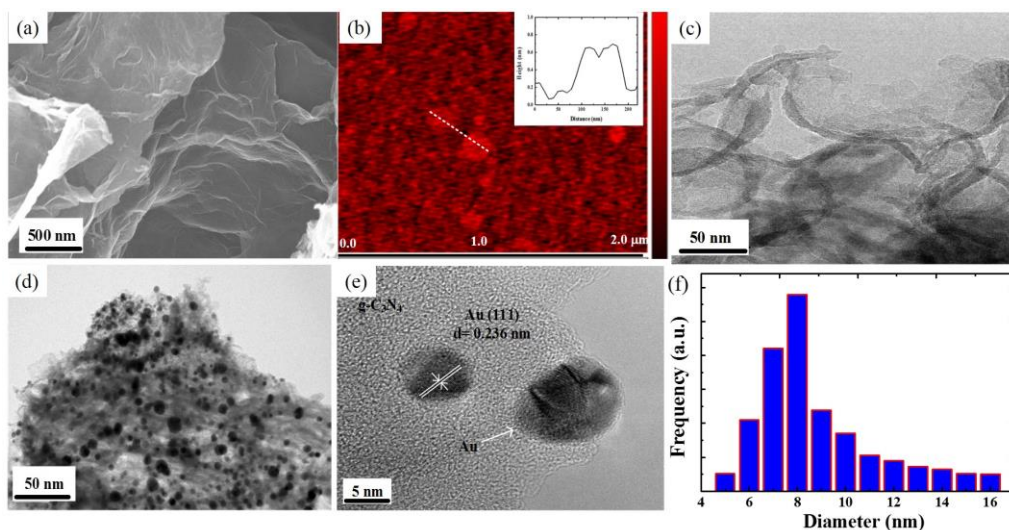
Fig. 1. (a)SEM, (b) AFM, and (c) TEM images of as-prepared g-C$_3$N$_4$ nanosheets; (d) TEM and (e) HRTEM images of Au@g-C$_3$N$_4$ nanocomposites, and (f) histogram of Au particle size distribution in Au@g-C$_3$N$_4$ nanocomposites.

Reduction of nitroarene over Au/g-C$_3$N$_4$

The morphology as well as the particle size distribution of as-prepared g-C$_3$N$_4$ nanosheets and Au@g-C$_3$N$_4$ nanocomposites are examined. **Fig. 1a** shows the SEM image of the exfoliated g-C$_3$N$_4$. The typical 2-D structure interconnected with wrinkled g-C$_3$N$_4$ nanosheets is observed vividly, indicating the successful split of bulk C$_3$N$_4$ layers into small and thin nanosheets via thermal exfoliation. The AFM image displays that the g-C$_3$N$_4$ nanosheets are well separated (**Fig. 1b**) with a thickness of *ca*. 0.7 nm (Inset of **Fig. 1b**), indicating the successful exfoliation of bulk g-C$_3$N$_4$ into 3–6 layers of C$_3$N$_4$ nanosheets. The TEM image (**Fig. 1c**) shows the lamellar structure of g-C$_3$N$_4$, which is formed by the linkage of graphitic-like planes. After loading 2 wt% of Au NPs, a homogeneous distribution of Au NPs on the g-C$_3$N$_4$ nanosheets is clearly observed in the TEM image (**Fig. 1d**), depicting the successful formation of Au@g-C$_3$N$_4$ nanocomposites. The HRTEM image clearly shows the characteristic lattice fringe with crystal plane distance of 0.236 nm (**Fig. 1e**), which corresponds to the (111) plane of face centered cubic (fcc) Au NPs. The strong interfacial interaction between Au NP and g-C$_3$N$_4$ layer is also observed in the HRTEM image, and is conducive to the electron transfer processes. Furthermore, the particle size distribution of Au NPs on g-C$_3$N$_4$ can be calculated from the histogram analysis, and the Au NPs on the g-C$_3$N$_4$ nanosheets are in the range of 5−15 nm with a mean diameter of 8 nm (**Fig. 1f**). The particle size of Au NPs on

g-C_3N_4 is smaller than that of Au NPs alone (18 nm), indicating that the g-C_3N_4 nanosheet is an excellent support to homogeneously disperse Au NPs that constrains the growth of Au NPs.

Fig. 2 shows the mass loading effect of Au NPs in Au@g-C_3N_4 on the catalytic reduction efficiency of 4-NP in the presence of 7 mM $NaBH_4$. It is clear that g-C_3N_4 is catalytically inactive on the reduction of 4-NP. Although the reaction of 4-NP (E^0 ($_{4-NP/4-AP}$) = −0.76 V) with $NaBH_4$ (= −1.33 V) is thermodynamically favorable, the reduction of 4-NP by $NaBH_4$ is kinetically slow. Addition of Au NPs significantly enhances the reduction efficiency and rate of 4-NP over Au@g-C_3N_4 in the presence of $NaBH_4$. The reduction of 4-NP to 4-amnophenol increases from 66 to > 99% when the Au loading increases from 0.5 to 2 wt%, and then slightly decreases to 96% at 3 wt% after 10 min of reaction. The pseudo-first-order rate constant (k_{obs}) for 4-nitrophenol reduction is 1.83×10^{-3} (r^2 = 0.998), 3.07×10^{-3} (r^2 = 0.995), 1.50×10^{-2} (r^2 = 0.983), and 5.33×10^{-3} sec^{-1} (r^2 = 0.997), respectively, over the 0.5-, 1-, 2- and 3-wt% Au@g-C_3N_4. When normalized to the specific surface area of Au@g-C_3N_4, the normalized surface rate constant (k_m) for 4-NP reduction increases from 3.24 to 20.25 min^{-1} m^{-2} at 0.5 – 2-wt% Au@g-C_3N_4 and then decreases to 6.78 min^1 m^{-2} at 3-wt% Au@g-C_3N_4, indicating that 2-wt% Au@g-C_3N_4 provides optimal active sites for both $NaBH_4$ and 4-NP to exhibit the best catalytic activity in comparison with other Au loadings of Au@g-C_3N_4.
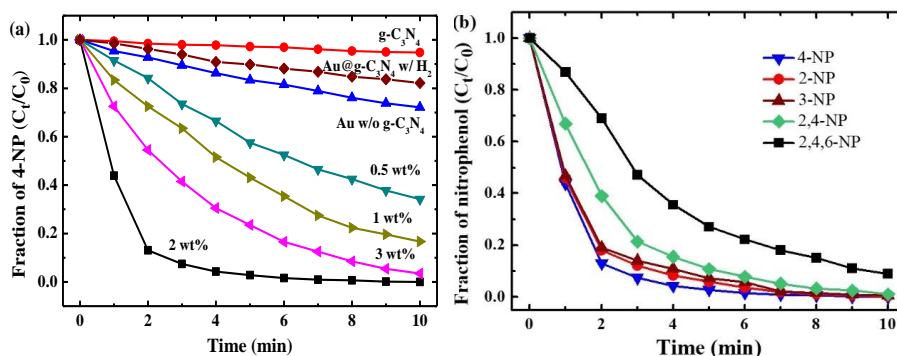
Fig. 2. (a) Effect of Au content on the reduction of 4-NP and (b) catalytic reduction of various nitrophenol compounds by Au@g-C_3N_4 nanocatalyst in the presence of $NaBH_4$.

To further understand the applicability of Au@g-C_3N_4 nanocomposite to catalyze the reduction of nitrophenol, several nitroaromatics including 2-NP, 3-NP, 4-NP, 2,4-DNP and 2,4,6-TNP are selected as the target compounds. As shown in **Fig. 2b**, the Au@g-C_3N_4 nanocomposite exhibits remarkable catalytic activity toward nitrophenol reduction by $NaBH_4$. Both the k_{obs} and normalized

surface rate constants of nitrophenol reduction follow the order: 4-NP > 2-NP > 3-NP > 2,4-DNP > 2,4,6-TNP, indicating 4-NP reduction the most favorable over Au@g-C_3N_4 nanocatalyst. The rate constant of nitrophenol reduction decreases with the increase in number of nitro-substituent, which is mainly attributed to the molecular hindrance and steric effect of nitroaromatics to penetrate into the catalyst network.

Photodegradation of pharmaceuticals over I, K-codopedd g-C_3N_4

Not just only shows the superior catalytic capability toward nitroarenes reduction, g-C3N4 also exhibit the excellent photocatalytic activity toward pharmaceuticals degradation. We have proposed a simple method to fabricate visible-light responsive iodine- and potassium-codoped for sulfamethoxazole (SMX) photodegradation. As shown in **Fig. 3a**. The)for SMX photodegradation were computed at 0.027, 0.035 and 0.106 min^{-1} at doping temperature of 450, 500 and 530 °C, respectively. The k_{obs} for SMX photodegradation by IK-C_3N_4 at 530 °C was 4 times higher than that at 450 °C. The increased reaction rate at high doping temperature is mainly attributed to the enhanced exfoliation and doping efficiency, resulting in the acceleration of photocatalytic performance towards SMX removal.
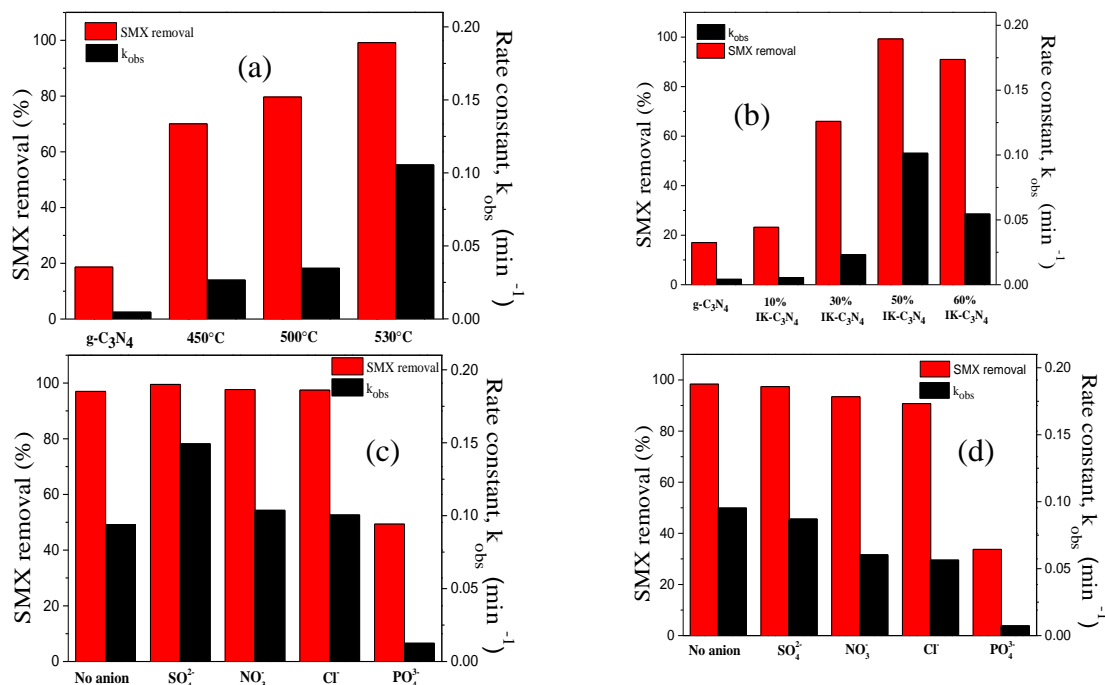
Fig. 3 Pseudo-first order kinetic rate constants and SMX degradation rate by as-synthesized photocatalysts under visible light irradiation at varying (a) calcination temperature, (b) dopant amount (c) 0.01 M anion, and (d) 0.05 M anions.

Fig. 3b shows that g-C_3N_4 has a slight photocatalytic activity toward SMX degradation and only 17.0% of SMX is photodegraded after 45 min of irradiation. In the absence of any photocatalyst, less than 2% of SMX is photodegraded under the visible light irradiation, indicating that the direct photolysis of SMX can be neglected. Nevertheless, all doped IK-C_3N_4 photocatalysts had better photocatalytic performance compared to pure g-C_3N_4 and the varying dopant amounts of IK-C_3N_4 composites exhibited different SMX photodegradation efficiencies. The degradation efficiency of SMX by IK-C_3N_4 follows the order: 50 wt% > 60 wt% > 30 wt% > 10 wt% **>** as-prepared g-C_3N_4 and increases from 23.2 % at 10 wt% to > 99% at 50 wt%. The superior photocatalytic performance of 50 wt% IK-C_3N_4 is mainly attributed to the homogenous dispersion and lattice defects caused by the co-doping of I and K into the g-C_3N_4 nanosheet that promotes good charge transfer and separation of e^-/h^+ pairs, which have been shown in PL spectra. In addition, the high specific surface area and pore volume provide more reactive sites for 50 wt% IK-C_3N_4 for the enhanced photocatalytic degradation efficiency. Also shown in **Fig. 3b**, the k_{obs} for SMX photodegradation value increases from 0.0055 min^{-1} for 10 wt% IK-C_3N_4 to 0.1014 min^{-1} for 50 wt% IK-C_3N_4 and then decreases to 0.0545 min^{-1} for 60 wt% IK-C_3N_4. The decline in photocatalytic activity is attributed to the shielding effect caused by extra defects at high dopant concentrations. The k_{obs} value of 50 wt% IK-C_3N_4 is 24.1 times higher than that of g-C_3N_4 (0.0042 min^{-1}), showing that the former is a superior visible-light-responsive photocatalyst for SMX photodegradation.

Inorganic salts are commonly found in actual water and wastewater samples. Therefore, the impact of anionic species on the photodegradation of SMX by 50 wt% IK-C_3N_4 was also examined in this study. The addition of 0.01 M anion (phosphate, sulfate, nitrate and chloride) to the water matrix enhanced SMX photodegradation efficiency for each of the anions except for PO_4^{3-} (**Fig. 3c**). The enhancement in SMX photodegradation efficiency follows the order: SO_4^{2-} > NO_3^- > Cl^-. Sulfate anions promote photodegradation since it is known to react with photogenerated holes generating other oxidizing radical and instigate the formation of $\cdot OH$ radicals after reacting with H_2O molecules. The k_{obs} for SMX photodegradation was found at 0.1493, 0.1037 and 0.1005 min^{-1} in the presence of 0.01 M SO_4^{2-}, NO_3^- and Cl^-, respectively which is 1.07 – 1.59 times higher than the control run (without anion). The observed increase in the reaction rate is ascribed to the transformation of the anions into radical species

that promoted the separation of the electron and hole pairs in an electrostatic field created on the surface of the photocatalyst. At higher anion concentration of 0.05 M, however, detrimental results were obtained for all anions. In **Fig. 3d,** the photodegradation efficiencies of SMX were 34, 91 and 93% and k_{obs} values of 0.0073, 0.0564 and 0.0604 min^{-1} for PO_4^{3-}, Cl^- and NO_3^-, respectively, after 45 min of irradiation. Although a nearly complete SMX photodegradation was found in the presence of 0.05 M SO_4^{2-}, the k_{obs} for SMX photodegradation was at 0.0871 min^{-1}, which is 1.09 times lower than that in the absence of anions. The difference in anion concentration affects SMX photodegradation due to the fact that at high concentration, they serve as OH radical scavengers consequently terminating radical formation [50] Thus, competition between SMX and anions for photogenerated holes and electrons resulted in the decrease in SMX photodegradation rate and efficiency. Moreover, phosphate anions are unique by consistently giving unfavorable effect during SMX photodegradation regardless of the anion concentration. This is mainly due to the decrease in adsorption of SMX onto the IK-C_3N_4 surface whenever there is sodium phosphate.
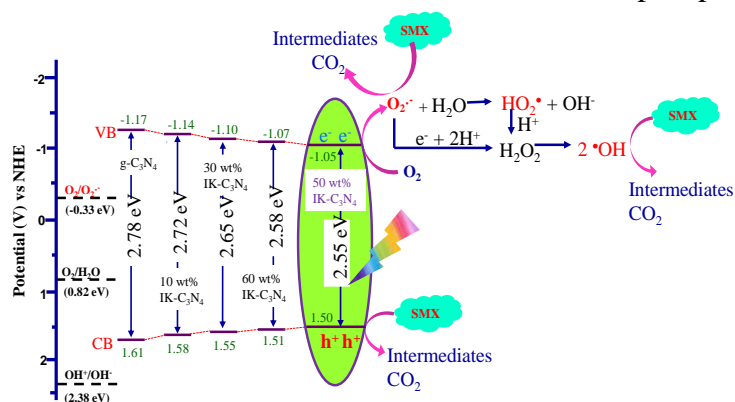
Fig. 4 The relationship of CB and VB position of various loading amounts of IK-C_3N_4 and the possible reaction mechanism for SMX photodegradation by IK-C_3N_4 under visible light irradiation.

The reaction mechanisms for SMX photodegradation by visible-light-responsive IK-C_3N_4 is also proposed. As shown in **Fig. 4**, the irradiation of IK-C_3N_4 with visible light would excite the electron from VB to CB and produce e$^-$-h$^+$ pairs. The electron in CB would react with oxygen (O_2) in aqueous solution to produce superoxide anion radicals ($O_2^{\bullet-}$) [2]. The superoxide anion radicals will undergo the chain reaction to generate hydrogen peroxyl radicals (HO$_2^{\bullet}$), hydrogen peroxide (H_2O_2) and hydroxyl radicals ($^{\bullet}$OH). Those photogenerated radicals and hole (h$^+$) can serve as the oxidizing agents to decompose pollutants, results in the acceleration of photocatalytic degradation efficiency and rate of SMX. It

is noteworthy that the standard reduction potential of $^\bullet OH^+/^\bullet OH^-$ is at 2.38 eV vs. NHE, while the VB position of IK-C$_3$N$_4$ only locates 1.50 – 1.61 eV. This means that the hole generated from the visible light irradiation cannot trigger the generation of $^\bullet OH$ from the reduction reaction of O$_2$. Therefore, the hydroxyl radicals in the solution can only be obtained from the chain reactions of superoxide anion radicals. This result is in good agreement with the result of the scavenger experiment on which the reactive species that dominate the reaction is arranged in this manner $O_2^{\bullet-} > h^+ > {^\bullet}OH$.

Photodegradation of pharmaceuticals over CeO2/IK-C3N4.

Cerium oxide (CeO$_2$), an abundant rare-earth oxide, is a n-type photocatalyst with band gap of around 2.8 - 2.92 eV, which makes it highly capable of absorbing light in the visible spectrum. The combination of CeO$_2$ and IK-C$_3$N$_4$ can form direct Z-scheme n-n heterjunction for enhanced photodegradation. **Fig. 5a** shows the adsorption and photodegradation of acetaminophen (ACT) over various amount of CeO$_2$/IK-C$_3$N$_4$. Only 12% and 15% ACT removal by pure g-C$_3$N$_4$ and 15% CeO$_2$/ IK-C$_3$N$_4$ nanocomposite in 90 min of continuous mixing. Moreover, the enhanced ACT removal was observed immediately after visible light irradiation, which confirms that the ACT elimination is mainly due to the photocatalysis. Different CeO$_2$ loading over g-C$_3$N$_4$ were optimized for enhanced photocatalytic degradation of ACT (**Fig. 5b**). The 10% weight of CeO$_2$ was recorded with only 60% ACT degradation, 1.56 times higher than that of g-C$_3$N$_4$. The 15% CeO$_2$/ IK-C$_3$N$_4$ nanocomposite was found to be the optimal ratio wherein highest photocatalytic performance was observed. After 90 min of visible light irradiation, 98% of ACT was eliminated. This boost in performance is mainly caused by the balance of lattice defects introduced while suppresses the recombination of excitants from increased in area for surface charge. Meanwhile, further increase produces a surplus CeO$_2$ that competes for reactive sites, blocks $_{available}$ light energy and produces more defects that causes the decrease in performance. The 20% and 25% CeO$_2$ immobilization show only 91% and 94% removal efficiency, respectively in 90 min of reaction time. The ACT degradation rate is modelled by a pseudo-first-order reaction and the k$_{obs}$ values are 0.0101, 0.0386, 0.0312, 0.0266 and 0.0053 min^{-1} for 10%, 15%, 20%, 25% CeO$_2$/IK-C$_3$N$_4$ and bare g-C$_3$N$_4$, respectively.
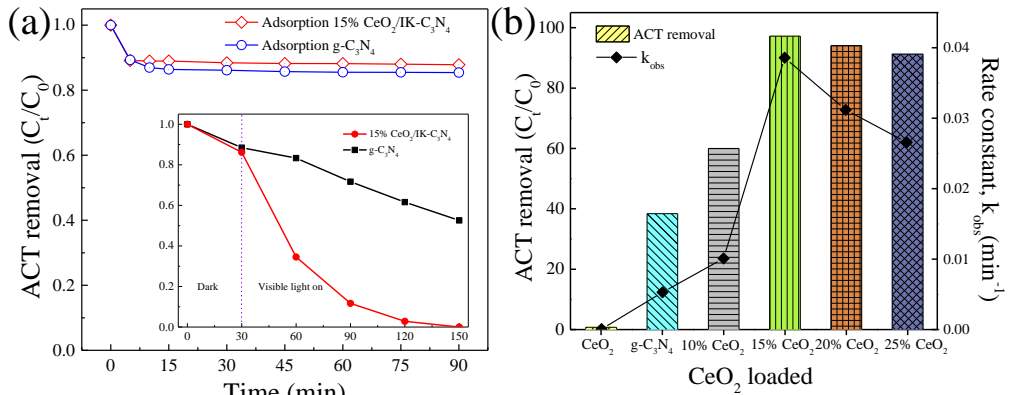
Fig 4. (a) Adsorption experiment, under visible light irradiation by 15% CeO₂/ IK-C₃N₄ nanocomposite and (b) corresponding first-order rate constant (k_{obs}) with different (b) CeO₂ loading on to the g-C₃N₄ catalysts.

In order to explain the degradation pathway performed by the photocatalytic system, the conduction band (E_{CB}) and valence band (E_{VB}) potentials of IK-C₃N₄ and CeO₂ was calculated by using the Mulliken electronegativity theory [2,3]:

$$E_{CB} = X - E_c + \frac{1}{2} E_g \quad (1)$$

$$E_{VB} = E_{CB} - E_g \quad (2)$$

where X is the geometric mean of Mulliken electronegativity constituent atoms, Ec is the hydrogen scale's energy of electrons (4.5 eV vs NHE) and E_g is the band gap energy. The X values are 4.72 eV for g-C₃N₄ and 5.56 eV for CeO₂. For IK-C₃N₄, the calculated E_{CB} and E_{VB} were -1.06 eV and 1.49 eV, respectively. The as-synthesized bare CeO₂ shows E_{CB} and E_{VB} equal to -0.43 eV and 2.55 eV. Based on the characterization, trapped radical species and calculated band structures, the probable charge carrier transfer path which helped to achieve the enhanced photodegradation by 15% CeO₂/ IK-C₃N₄ heterojunction (**Fig. 5**). The overlapping band energy levels of IK-C₃N₄ ($E_{CB} = -1.06, E_{VB} = 1.49$) and CeO₂ ($E_{CB} = -0.43, E_{VB} = 2.55$), generated an effective structure for a heterojunction.

$$CeO_2 + \hbar v \rightarrow CeO_2 (e^- + h^+) \quad (3)$$

$$IK - C_3N_4 + \hbar v \rightarrow IK - C_3N_4 (e^- + h^+) \quad (4)$$

$$CeO_2 (e^-) \rightarrow IK - C_3N_4 (h^+) \quad (5)$$

$$CeO_2 (h^+) + H_2O \rightarrow OH^. \quad (6)$$

$$IK - C_3N_4 (e^-) + O_2 \rightarrow O_2^- \cdot \quad (7)$$

$$OH^. , O_2^- \cdot \text{ and } h^+ + ACT \rightarrow H_2O + CO_2 + by-products \quad (8)$$
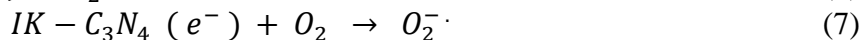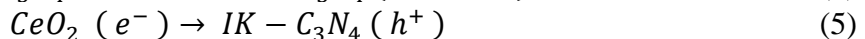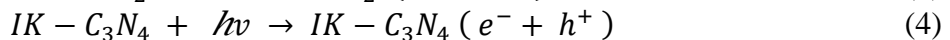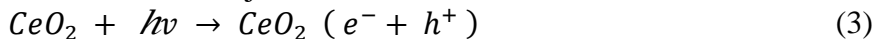
Under visible light irradiation, with enough photons to surpass the energy gap, both IK-C_3N_4 and CeO_2 produce photoexcited electron and hole pairs. Subsequently, the electrons are transported in the conduction band (CB) of CeO_2 to the valence band (VB) of IK-C_3N_4, Eq. (5) and holes left in VB of CeO_2 will produce •OH from H_2O, Eq. (6). The accumulated electrons that leaped to the CB will reduce the molecular oxygen to produce O_2•$^-$ immediately (Eq. (7)). Meanwhile, the holes left in the VB will interact with the organic molecules. Finally, the produced radical species of O_2•$^-$ and •OH will interact with the ACT molecules for degradation (Eq. (8)). On the basis of the scenarios mentioned, SEM/TEM topography image and XPS results, it is clearly that there is an interfacial interaction between the two semiconductors, and, thus, direct Z-scheme is achieved. The photogenerated e$^-$ with higher reduction potential are gathered on the CB of IK-C_3N_4 while the h$^+$ with higher oxidation potential remained on VB of CeO_2 which optimizes the redox potential of the heterojunction to intensify its degradation capabilities. Moreover, due to the transfer mechanism by Z-scheme, efficient transport of electrons from CeO_2 to g-C_3N_4 and suppress recombination of photo-generated pairs became achievable.
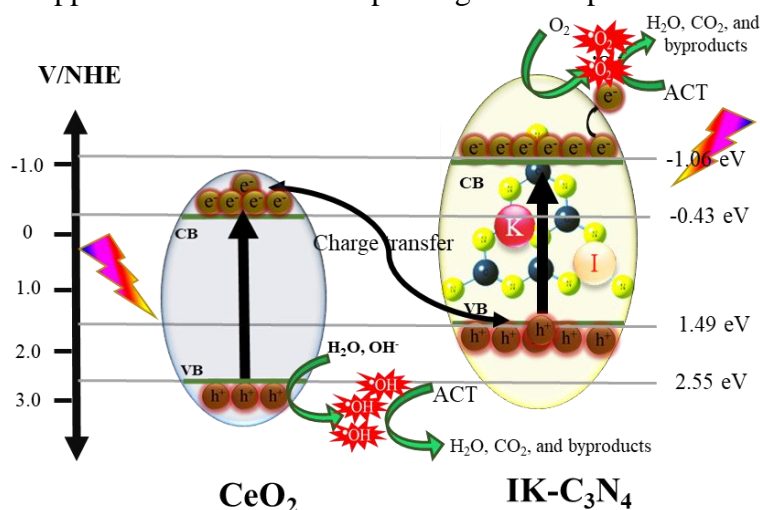
Fig 5. Schematic illustration of the charge transfer in a direct Z-scheme heterojunction

IK-C_3N_4 alone does not have the capacity to yield •OH radicals from photogenerated holes (1.49 eV) but as soon as it was paired with CeO_2, the oxidation potential maximizes to 2.55 eV, sufficient enough to produce these reactive radicals (2.4 eV vs NHE) (Bao and Chen, 2016). Unlike in a typical heterojunction, the holes were gathered in the VB of CeO_2 instead of IK-C_3N_4's which is an evidence of direct Z-scheme course. The result of the experiment conforms to the calculated band positions of the two semiconductors and

confirms their capacity to directly generate reactive species, $O_2\bullet^-$ and $\bullet OH$ In addition, the radicals identified illustrate that the separation and transfer of generated e^-/h^+ pairs followed a Z-scheme path.

Conclusions

In this study, we have developed a simple and facile synthesis method for the fabrication of metal/metal oxide@doped g-C_3N_4 nanocomposite for the rapid removal of nitroarenes and parmaceuticals including 4-NP, SMX and ACT. Au NPs with an average diameter of $5 – 15$ nm are well deposited onto the surface of g-C_3N_4 in $3 – 6$ layers structure. The as-prepared Au@g-C_3N_4 nanocomposite exhibits good catalytic properties for nitrophenol reduction in the presence of NaBH$_4$ and the reaction rate follows the order: 4-NP > 2-NP > 3-NP >2,4-DNP > 2,4,6-TNP. After the co-doping with I and K, the band structure and optical properties of IK-C_3N_4 can be fine tunes, resulting in the enhance photocataytic activity toward SMX degradation. Moreover, addition of CeO2 can shift the reaction mechanism to direct Z-scheme. More efficient charge transfer and reduced recombination of electron-hole pairs was established. Meanwhile, introduction of anions in the reaction may promote or inhibit the photocatalytic degradation depending on the concentration being added. The radical trapping experiments showed that hydroxyl radical ($^\cdot OH$), superoxide radical ($^\cdot O_{2^-}$) and hole (h^+) were all responsible for the enhanced photocatalytic degradation of pharmaceuticals. Results clearly demonstrate that g-C_3N_4 is superior photocatalyst as well as an excellent support, which can form a promising green (photo) catalyst with enormous potential of application including nitroaromatic reduction and emerging pollutant photodegradation, which provides a new venue for tailoring C_3N_4-based nanomaterials in elucidation of a wide variety of heterogeneous catalytic reactions.

[1] Nguyen, T. B.; Huang, C. P.; Doong, R. A. (2019). Enhanced catalytic reduction of nitrophenols by sodium borohydride over highly recyclable Au@graphitic carbon nitride nanocomposites. Appl. Catal. B Environ. 240, 337-347.

[2] De Luna, M. D. G.; Paragasb, L. K. B.; Doong, R. A. (2019) Insights into the rapid elimination of antibiotics from aqueous media by tunable C_3N_4 photocatalysts: Effects of dopant amount, coexisting ions and reactive oxygen species. Sci. Total Environ. 669, 1053-1061.

[3] Paragas, L. K. B.; De Luna, M. D. G.; Doong R. A. (2018). Rapid removal of sulfamethoxazole from simulated water matrix by visible-light responsive iodine and potassium co-doped graphitic carbon nitride photocatalysts. Chemosphere, 210, 1099-1107.

[4] Saha, R. S.; Lee, D. L.; Doong, R. A. (2018) Enhanced reactivity of reduced graphene oxide supported bimetallic Fe/Ni nanoparticles for trichloroethylene dechlorination, Chem. Eng. J. 334, 30-40.

Abstract of the Invited Speech

Electrospun nanomaterials for drug delivery, tissue engineering and cancer therapy

Prof. K.M. Nalin de Silva

Department of Chemistry, Faculty of Science, University of Colombo, Colombo, Sri Lanka

Electrospun polymeric nanofibers have proven to be a versatile strategy in designing drug delivery systems, tissue regeneration applications and cancer therapy. The high surface-to-volume ratio of the nanofibers can enhance cell binding and proliferation, drug loading, and mass transfer processes. The most important and studied areas of electrospinning lies in the fields of drug delivery and tissue engineering. Electrospinning technique allows designing of drug delivery systems with modified drug release profiles for various active substances ranging from active pharmaceutical ingredients, inorganic particles and macromolecules. Various classes of drug types including anti-inflammatory, anti-microbial, anticancer, cardiovascular, anti-histamine, gastrointestinal, palliative and contraceptive drugs can be loaded into novel polymeric blends as well as multilayered nanofibers. Electrospinning also plays a major role in designing artificial tissue scaffolds (ex: skin scaffolds and bone tissue scaffolds) for regenerative medicine applications. Use of electrospun artificial scaffolds allows an alternative to the autologous split skin grafts avoiding the generation of a secondary wound from donor site and avoids unnecessary extra pain to the patient. Electrospinning technique may have the potential to be enhanced and therein lies opportunity for future research in this field.

A novel parasitic nematode-specific protein as a potential drug target against elephantiasis

Dharshika S. A.*, Dharshika R., Gowthami M., Silva G.N. and Dassanayake R.S.

Department of Chemistry, Faculty of Science, University of Colombo, Colombo, Sri Lanka

Elephantiasis is an infective deleterious disease caused by a thread like nematode parasite, *Wuchereria bancrofti*. The discovery of drugs for the elephantiasis against adult worms is challenging, because of the significant complications in procuring adult parasites from the lymphatic system. Therefore, *Setaria digitata*, a model organism which closely resembles *W. bancrofti* is widely used to study the parasitology of *W. bancrofti*. The uncharacterized novel, parasitic nematode-specific protein called *S. digitata* novel protein (SdNP) which is expressed in all the stages of the life cycle and essential for the survival was identified from *S. digitata*. The research work presented here describes *in vitro* characterization of SdNP. Built on Bioinformatic analysis, an enzyme coupled ATPase assay was used to detect the ATPase activity of the putative kinase motifs. Our results confirmed that SdNP is a phosphor-protein that can bind and hydrolyze ATP to ADP and inorganic Pi in a substrate-independent manner. In addition, native-PAGE and gel-filtration chromatography results showed that SdNP forms a stable tetramer *in vitro*. The fact that SdNP is unique and essential for parasitic nematodes suggests that, it is a potential drug target against elephantiasis. Therefore, elucidation of its role impacts the global health care directly and positively.

Keywords: *Setaria digitata*, SdNP, ATPase activity and tetramer

*Corresponding author: anne16793@gmail.com

Screening of T_2 transgenic plants to evaluate the expression of RKN parasitism gene

Maleesha W.L.D.S., Rajapakse R.V.D.U.P., Dassanayake R.S.D. and Hettiarachchi G.H.C.M.*

Department of Chemistry, Faculty of Science, University of Colombo, Colombo, Sri Lanka

Root Knot Nematode (RKN) infection is a major plant pathogenic disease that is of great economic importance. RKN parasitism genes are responsible for the formation of 'giant feeding cells' by up-regulating the plant transcription factors during infection. T_2 transgenic plants which were previously developed to overcome RKN infection were screened in this study for the presence of RKN parasitism gene. The presence of RKN parasitism gene in the transgenic tomato plant genome was tested with qPCR amplification. This was further confirmed with sequencing the positive samples and blast analysis. Expression levels of the transgene under pathogenic stress were analyzed with qPCR amplification. Two different techniques were optimized for the staining of the RKN egg masses. Non transgenic tomato plants under similar conditions were used as the control group. The Presence of transgene were detected in strains $17T_2$ 1.2, $17T_2$ 2.1, $17T_2$ 3.3 and $19T_2$ 2.2. This establishes the presence of the introduced transgene across generations. Relative quantification of transgene cDNA with the housekeeping gene *lat* indicates a 4.72-fold higher expression level of transgene in transgenic plants due to pathogenic stress by RKN infection. This indicates the presence and increased expression of the targeted gene in the transgenic tomato plants. This may be due to activation by the pathogenic stress induced from RKN infection. Thus the plant strain $19T_2$ 2.2 can be used as host plants for RNAi silencing of the parasitic RKN expressing RKN parasitism gene. McCormick Red food dye can be used to effectively stain RKN egg masses.

Keywords: parasitism, root knot nematode (RKN), transgenic and qPCR

*Corresponding author: chamarih@chem.cmb.ac.lk

Faculty of Science
University of Ruhuna

RISTCON
2020

Application of an electric potential to retain soil nutrients around the root zone in rice (*Oryza sativa* L.) using carbon electrodes

Athukorala A.N.[1]*, Senevirathne G.I.[2], Chathurika J.A.S.[2], Rathuwadu N.[2], Gunawardana M.[2] and De Silva C.S.[1]

[1]*Department of Agricultural and plantation Engineering, Faculty of Engineering Technology, Open University of Sri Lanka*
[2]*Sri Lanka Institute of Nanotechnology, Pitipana, Homagama*

Leaching of soil nutrients from the root zone into the deeper layers affects the crop production: especially in waterlogged rice cultivation causes problems to environmental and human health. This study aims to evaluate the effect of electric potential in retaining soil nutrients around the root zone of rice. A leaching column study was carried out to compare ion retaining ability in the presence of an electric field using different electric potentials, 2V, 5V and 8V with time combinations of 4h, 8h and 12h. Effect of applying an electric potential to retain soil nutrients around the root zone was evaluated by assessing the effect on soil properties, growth and yield of rice. A lowland rice variety BG250 was used for pot experiment. Amount of nutrients leached was analyzed by a leach column study. The results revealed that the nutrients have retained in the upper part of the leaching column where the electrodes were positioned. The pot trial results suggested that, applying 2V electric potential was the best among combination of treatments in retaining nutrients around the root zone. All the growth and yield parameters were positively influenced by application of an electric potential compared with control. The increase in the rice yield percentages in the 2V and 5V, were 24%, and 5% respectively compared to the yield in the control. Therefore, application of an electric potential could be recommended to reduce leaching of nutrient and improve crop productivity. Future studies are needed to investigate effect of electric potential on different crop types, electrode types and electrode positioning distances for better outcomes.

Keywords: leaching, electric potential and electrodes

*Corresponding author: aruni.athukorala@yahoo.com

Climate change-related constraints for home gardening of women-headed families in Cheddikulam, Sri Lanka

Senarathna S.A.S.R.[1], Ginigaddara G.A.S.[1]*, Kodithuwakku A.N.[1] and Vimaladhas V.[2]

[1]*Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[2] *Community Seed Bank, 2nd farm, Muhanthankulam, Cheddikulam, Sri Lanka*

Home gardening (HG) was introduced to ensure the sustainable income generation and food security of people in Cheddikulam after ending the civil war of the country in 2011. Even though HG is satisfactorily practiced for 7 years, climate change has impacted on HG severely. This study was conducted to identify the climate change-related constraints for HG for the last seven years in the area and to suggest effective strategies to address climate change for the home gardeners. Hundred home gardeners of women-headed families in the Cheddikulam Divisional Secretariat Division were selected and key person interviews and group discussions were conducted for data collection. Results revealed that wild animal attacks on crops (63%), severe drought conditions (100%), contagious livestock diseases (88%), lack of feed availability for the animals (85%), unexpected floods (100%) as main climate change-related constraints in home gardening. The entire study population was victimized from floods that occurred in 2012 and 2014 and their home garden cultivations were destroyed. The prolonged drought occurred in 2015 reduced their livestock populations drastically mainly due to the emergence of contagious livestock diseases (88%), lack of feed availability and malnutrition of livestock (85%). Water scarcity was found (80%) to be the main limitation for HG and reducing their cultivation extents was identified as the only adaptation strategy practiced by the home gardeners. The contribution of HG to the family monthly income was found to be 24%. Hence there is a mandatory requirement for introducing climate change adaptation strategies such as climate-smart agriculture, drought-resistant varieties, efficient water management strategies, rainwater harvesting systems and crop diversification in home gardening to improve the rural wellbeing of the women-headed families in Cheddikulam, Sri Lanka.

Keywords: climate change, climate-smart agriculture, home gardening and women-headed families

*Corresponding author: sanjeewanieg@gmail.com

Effect of plant density and leaf pruning on growth and yield performance of okra (*Abelmoschus esculentus* (L.) Moench) varieties

Darmica G.*, Sivachandiran S. and Asharp G.

Department of Agronomy, Faculty of Agriculture, University of Jaffna, Kilinochchi, Sri Lanka

Okra is an important vegetable grown in the tropics and subtropical parts of the world. The major constraints in okra production are pest and disease incidences and low productivity. A field experiment was conducted to evaluate the effect of different plant density and leaf pruning practice on growth and yield performance of okra varieties (Haritha and MI-5). The study was carried out at Integrated Farm and Training Center, Faculty of Agriculture, University of Jaffna, Kanakarayankulam during January to May 2019. The treatments consisted of leaf pruning (with leaf pruning and without leaf pruning) and different numbers of seedlings per hill (one plant per hill, two plants per hill and three plants per hill) on two varieties of okra. These treatments were laid out in a split plot design with three replicates. Analysis of data was performed using the statistical software SAS 9.1 for calculating both ANOVA and Duncan's mean separation. The number of plants per hill and the leaf pruning on two okra varieties have shown significant ($p<0.05$) effect on the plant height, leaf-number per plant, number of branches per plant, leaf area, number of pods per hill, single pod weight and total yields of both okra varieties. There were no any significant differences observed in pod length, circumference and number of ridges per pod for both okra varieties. Disease incidence was significantly influenced 16.7% to 37.8% when increasing the number of seedlings per hill. Yellow Vein Mosaic Virus incidence was higher in MI-5 than Haritha variety. Raising two seedlings per hill with leaf pruning have shown significantly higher growth and yield performance in Haritha (17 t/ha) 13.33% increment of the yield and MI-5 (18 t/ha) 20% increment of the yield compared to other levels of treatment (20%). Therefore, these results could be used effectively in farmer's field to maximize the profitability in okra cultivation.

Keywords: growth, leaf pruning, okra, plant population and yield

*Corresponding author: gobalakumarandarmi@gmail.com

Cultivation of selected microalgae in dairy wastewater for the production of natural astaxanthin

Nishshanka G.K.S.H.[1], Liyanaarachchi V.C.[1], Nimarshana P.H.V. [2] and Ariyadasa H.L.T.U.[1]*

[1]*Department of Chemical and Process Engineering, University of Moratuwa, Bandaranayaka Mawatha, Moratuwa 10400, Sri Lanka*
[2]*Department of Mechanical Engineering, University of Moratuwa, Bandaranayaka Mawatha, Moratuwa 10400, Sri Lanka*

Freshwater microalgae species, *Haematococcus pluvialis* and *Chlorella zofingiensis* accumulate high quantities of natural astaxanthin. Nonetheless, cultivation of these microalgal species requires a large quantity of supplementary nutrients and freshwater to facilitate cell growth, photosynthesis and to overcome evaporative losses. With increasing water scarcity, directing large quantities of freshwater for microalgae cultivation can be controversial. Hence, the cultivation of these species in dairy wastewater could be an alternative for using freshwater. Additionally, wastewater contains nutrients such as nitrogen, phosphorus and organic carbon, which facilitate microalgal growth. In this study, the ability of dairy wastewater to support growth and astaxanthin accumulation of *H. pluvialis* and *C. zofingiensis* was assessed, with the aim of reducing the requirement for freshwater and additional nutrients. Both species exhibited considerable growth in synthetic dairy wastewater with final biomass concentration of 0.575 ± 0.007 g/L and 0.595 ± 0.007 g/L for *H. pluvialis* and *C. zofingiensis* respectively. Two-tailed t test indicated no significant difference between microalgal growth in dairy wastewater and Bold's basal medium (control), suggesting it could be used as a substitute for standard growth medium. Astaxanthin concentration in the microalgal culture was measured using spectrophotometry subsequent to solvent extraction. The highest astaxanthin content (w/w) was observed in *H. pluvialis* grown in dairy wastewater, which was 25.3% higher than that of the control. In comparison, *C. zofingiensis* cultivated in dairy wastewater indicated a 6.5% increase compared to its control. Thus, results of this study indicate that astaxanthin production from microalgae cultivated in dairy wastewater could provide a sustainable alternative to using freshwater.

Keywords: microalgae, dairy wastewater and astaxanthin

*Corresponding author: thilini@uom.lk

Faculty of Science
University of Ruhuna

RISTCON
2020

Vocalization behavior of goats (*Capra hircus*) in relation to two routine management practices: feeding and milking

Senaratna D.*, Priyadarshanie W.A.S. and Atapattu N.S.B.M.

Department of Animal Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Animals communicate through vocalization reflecting physiological, environmental and status of their welfare. The objective of the study was to determine the changes of vocal behavior (VB) of Jamunapari cross bred goats in relation to two management practices; feeding and milking. The intensity of sound and the associated VB were observed using a mobile application and an ethogram respectively. Sounds of goat kids (<3 months, n=5), females (1-2 years, n=5) and males (1-2 years, n=8) were measured by adopting Randomize Complete Block Design while they were in the same usual herd. All the individuals in different categories were in the same physiological status. Treatments were feeding (T1) and milking (T2). Data either before or after feeding (T1) and milking (T2) were taken nine times (replicating the time) a day hourly. General behaviors in relation to vocalization were observed under in-house condition. Data were analyzed using SPSS version 22. Intensity of calls of males was significantly ($p<0.05$) higher among male animals (60.81dB) compared to females (36.75 dB) and kids (54.31 dB). Mouth opening (MO) while moving was the most prominent behavior in vocalization. Full and partial MOs while either walking or running were associated with vocalization. Significant differences showed between MO and vocalization before and after feeding ($P<0.05$). More full-MO (55.55%) than partial MO (44.45%) were shown before feeding. In contrast, after feeding partial MO (75%) dominated over full MO (25%). Situation of milking was not affected the VB ($P=0.383$). However, VB before milking was comparatively higher (40%) than after milking (35%). It can be concluded that VB of goats is changed in relation to feeding, but not to milking.

Keywords: feeding and milking, goats (*capra hircus*), management practices and vocal behavior

*Corresponding author: dulcy@ansci.ruh.ac.lk

RISTCON
2020
Faculty of Science
University of Ruhuna

Preliminary study of PFK1 and PFK2 encoding gene knockout by CRISPR-Cas9 system in MCF7 cancer cells

Jayaweera S.P.E.*, Prasadi W.K.S.*, Silva G.N. and Dassanayake R.S.

Department of Chemistry, Faculty of Science, University of Colombo, Colombo 00300, Sri Lanka

Clustered Regularly Interspaced Short Palindromic Repeats associated RNA guided endonuclease 9 (CRISPR-Cas9) system is a programmable genome engineering technique, which can be employed to facilitate efficient genome engineering by simply specifying a 20-nt targeting sequence (crRNA) which is complementary to the desired target site. This study utilizes CRISPR/Cas9 system to modify two vital genes, *pfk1* and PFKFB3, which encodes PFK1 (Phosphofructokinase-1) and PFK2 (Phosphofructokinase-2) enzymes that are involved in regulation of glycolysis, cell cycle and apoptosis. To investigate the impact of PFK1 and PFK2 encoding gene knockout on cancer, MCF-7 cells were utilized. Specific target sites to achieve knockout of respective genes were discovered through bioinformatics tools followed by designing target specific crRNAs and repair donor template with desired properties for downstream assays. Then crRNAs specific for *pfk1* and PFKFB3 were separately cloned into pSpCas9(BB)-2A-Puro plasmids. Verification of recombinant plasmids was achieved through colony PCR and sequencing. Sequencing results indicated that the crRNA sequence is integrated accurately to the intended site of the plasmid in the correct orientation. After the initial Polyethylenimine mediated transfection of recombinant plasmids carrying crRNA and Cas9 gene into MCF-7 cells, transformed cells were selected using Puromycin. Subsequent *Western* blot did not produce expected bands with desired intensity which was carried out to verify gene silencing. Future work includes optimization of transfection, downstream verification procedures such as T7 endonuclease assay and restriction digestion assay to validate CRISPR mediated knockout of *pfk1* and PFKB3 genes and determining the effect of gene knockout on cancer cell growth and proliferation.

Keywords: CRISPR-Cas9, gene knockout, *pfk1* and PFKFB3

*Corresponding authors: shansajaya100@gmail.com and wksprasadi@gmail.com

RISTCON
2020

Faculty of Science
University of Ruhuna

Identification of sugarcane inter-specific hybrid progenies through conventional and molecular methods

Koshila H.V.A.S.[1], Hemamali K.K.G.U.[1]*, Wijesuriya A.[2] and Perera A.M.M.S.[2]

[1]Department of Botany, University of Ruhuna, Matara, Sri Lanka
[2]Department of crop Improvement, Sugarcane Research Institute, Udawalawe, Sri Lanka

True hybrid identification through molecular analysis has become a more reliable approach in plant breeding. Four inter-specific hybrid families (Badila x Mandalay, Korpi x IS 76 219, SLC 92 72 x SLC 92 51, SLC 12 96 x Irrity 03) with 12 progenies from each of *Saccharum officinarum* and *Saccharum spontaneum* established in the field were evaluated to identify true hybrids for the purpose of sugarcane variety improvement. Morphological characteristics namely stalk length, stalk diameter, number of millable stalks per clump, field brix, rind hardness, number of internodes per stalk, stalk weight per clump, leaf length and width were used to identify true hybrids. A total of 21 progenies were identified as hybrids under conventional breeding. Molecular analysis was performed to confirm the results of conventional breeding. Genomic DNA was extracted from the progenies and the respective parents of each inter-specific cross. Eight microsatellite loci were amplified from the DNA extracts of each sample using primers which were designed and developed by the International Consortium of Sugarcane Biotechnology (ICSB). Two primers namely SMC1814LA and mSSCIR74 were amplified the DNA extracts of both parents and the progenies. The PCR products were resolved through Poly-Acrylamide Gel Electrophoresis (PAGE). A total of twelve inter-specific hybrid progenies namely 1-1, 1-3, 1-4, 1-6, 2-2, 2-3, 2-4, 2-5, 2-6, 2-9, 3-2 and 3-10 were identified as true hybrids out of 48 hybrid progenies by using both conventional and molecular biological analysis for use in the future back crosses in sugarcane crop improvement.

Keywords: hybridization, hybrid identification, molecular analysis and sugarcane

*Corresponding author: upekshahe@yahoo.com

Seed tuber size on growth and yield of selected potato (*Solanum tuberosum* L.*)* varieties in Kilinochchi district of dry zone (Dl₃) of Sri Lanka

Amirthavarssiny K.[1]*, Pradheeban L.[1], Amirthaloyanan A.[2] and Arasakesary S.J.[2]

[1]Department of Agronomy, Faculty of Agriculture, University of Jaffna, Ariviyal Nagar, Killinochi, Sri Lanka
[2]Regional Agriculture Research and Development Centre, Iranaimadu, Kilinochchi, Sri Lanka

Potato (*Solanum tuberosum* L.) is an important food and cash crop mainly grown in up country, wet and intermediate zones of Sri Lanka. Yield of potato is affected by number of factors like variety, weather, soil and size and quality of the seed tubers. Among which unspecfied seed tuber size, inadequate seed supply of suitable varieties at correct time, high cost of seed tubers and climatic change are main constraints in potato cultivation. The experiment was conducted to study the effect of tuber size on growth and yield of selected varieties of potato at Regional Agriculture Research and Development Centre, Iranamadu, Kilinochchi (DL₃) under experimental field during 2019. Treatment combinations consisted with 6 varieties (Laperla - Netherland, DHR1- America, Prada - France, Betty - France, Sassy – France and Palukka were imported by Heyley's of Sri Lanka) with three seed tuber sizes (according to their weight classes of each variety divided as small, medium and large). Experiment was conducted as 2 factor factorial and laid in Randomized Complete Block Design with three replicates. The results showed that phenoloy {number of days to germination, flower, and maturity (90-105 days) % of death (by incidences of major diseases, early blight and wilt)}, growth (in terms of stem number, number of leaves in main stem and height of the main stem) and yield parameters (marketable yield, unmarketable yield, number of tubers per plant and total tuber yield) were significantly influenced by the size of seed tuber and variety Prada and DHR1 produced the highest total tuber yield and marketable yields than the other varieties. Large and medium size seed tubers produced the higher marketable tuber yields than the small size seed tubers. The results of this study showed Prada and DHR1 varieties planted with medium (60 – 100g - Prada, 60- 90g- DHR1) to large size (100- 140g Prada, 90-120g - DHR1) seed tubers performed better than the other 4 varieties. Therefore, the potato varieties Prada and DHR1 can be suggested as suitable for growing in Kilinochchi district of Dry Zone (DL₃) of Sri Lanka.

Keywords: phenology, potato, tuber size, varieties and yield

*Corresponding author: amirthavarssiny@gmail.com

Effects of glyphosate banning on maize cultivation; a survey in selected agricultural instructor (AI) divisions in Anuradhapura district

Kahawandala K.R.N.S.K.M.B.* and Bandara A.M.K.R.

Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka

Maize is a popular course grain grown in the dry zone of Sri Lanka. Glyphosate was the most popular and effective herbicide used in maize cultivation until it was banned in Sri Lanka, in 2015. Without introducing a substitute to control weeds in maize, glyphosate banning was huge problem in the farming community. Hence, the study aims to investigate the effects of glyphosate banning on the maize cultivation and adaption methods used by maize farmers. Primary data (cost of production and cultivation extent data) were collected by field survey using purposively selected 60 farmers from Kahatagasdigiliya, Horowpathana and Galenbindunuwewa agricultural instructor (AI) divisions in Anuradhapura district. Multiple linear regression was utilized to find the effect of glyphosate banning on cultivation extent, maize production and cost of production. The categorical variable, adequacy of rainfall was used to remove the effect of rainfall. The results revealed that cultivation extent and yield were not significantly affected by the glyphosate banning while it affected to the cost of production (COP, $p<0.05$). The average COP per acre has increased from Rs. 47,701 to Rs. 57,254 with banning of glyphosate. About 39% of respondents had used other recommended herbicides and 28% of respondents had used Monosodium Glutamate while 23% of respondents use kerosene oil with other chemicals as alternatives for glyphosate. The study concludes that banning of glyphosate has significantly increased the COP, hence the cost-effective alternative weed control methods should be introduced for the sustainability of maize cultivation.

Keywords: cost of production, glyphosate and maize

*Corresponding author: nimanthakelum@gmail.com

Faculty of Science
University of Ruhuna

RISTCON
2020

Effect of simulated digestion using synthetic and natural gastrointestinal enzymes on the total phenol, total flavonoid and antioxidant capacity of commonly consumed raw and boiled legumes in Sri Lanka

Afka D.F.[1,2], Saritha W.[3], Rizliya V.[1], Kaushalya S. [1,2], Asini P.[1], Isuri R.[1], Barana J.[3] and Ruvini L.[1]*

[1]*Laborotary of Nutritional Biochemistry, National Institute of Fundamental Studies, Hanthana Road, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Animal Science and Fisheries, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*

Different processing methods and gastrointestinal digestion is known to modulate the bio-accessibility and bioavailability of bioactive compounds in food. This study focuses on the effect of processing and simulated digestion on antioxidant capacity, phenolic and flavonoid content of chickpea, mung (mi6), cowpea (Waruni), cowpea (Dawala) and horse gram (kollu). The raw and boiled legume samples were digested by using synthetic and natural (Swine) gastrointestinal enzymes. The total phenol (TP) content in experimental legume samples were assessed using Folin-ciocalteu method. The antioxidant capacity in experimental legume samples were determined using DPPH (2,2-diphenyl-1–picrylhydrazyl), ABTS (3-ethylbenzothiazoline-6-sulphonic acid) and FRAP (Ferric reducing power) methods. All the experiments were carried out in triplicate and three factor factorial model was used to analyze the data. According to the results it shows that boiling and simulated digestion modulate the bio-accessibility of antioxidants and their capacity. Simulated digestion with both synthetic and natural gastrointestinal enzymes increased ($p \leq 0.05$) TP and antioxidant capacity in legume samples. digested horse gram (kollu) showed the highest ($p \leq 0.05$) amount of phenolics (20.66 ± 1.58 mgGAE/g/19.33 ± 2.73 mgGAE/FDg) while undigested cowpea (Dawala) and chickpea showed lower phenolics compared to the rest. However, boiling showed a reduction ($p \leq 0.05$) in TP and antioxidant capacity of selected legumes. Boiled cowpea (Dawala) showed the lowest TP (13.59 ± 0.18 mgGAE/g/7.71 ± 0.18 mgGAE/FDg) and antioxidant capacity. A similar trend to TPC results was observed in FRAP and ABTS assays which reveals a positive correlation with total pheolic content. Overall results reveal that the processing and simulated digestion modulates the bioavailability of TP and the antioxidant capacity of above five selected legumes.

Keywords: antioxidant activity, bioavailability, flavonoids, simulated digestion and phenol

*Corresponding author: Ruvini.li@nifs.ac.lk

Synthesis of Pt(II) complexes of an pyridyl azafluoranthene ligand

Perera S.D.*

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

Fluoranthenes incorporate a five-membered ring as part of their fused skeleton and have been used to prepare curved aromatic ring systems. They have been used in light emitting devices and detection of explosives. Cyclometallated (NNC)Pt fragments are capable of harvesting light. Thus, it is of interest to explore the chemistry of the pyridyl azafluoranthene ligand (**1**) with Pt. Here we report the synthetic routes to complexes of the type [(NNC)PtX] and [(NNC)Pt(L')]PF$_6$; X = halide, acetylide; L' = PPh$_3$ or pyridine.
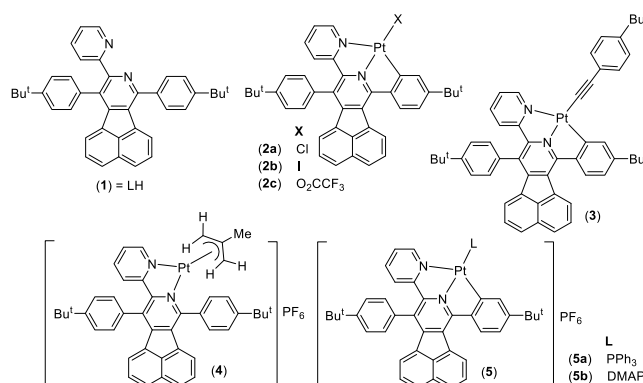
Treatment of (LH) (**1**) with [PtCl$_2$(dmso)$_2$] gave the cyclometallated Pt(II) complex [PtCl(L)] (**2a**) containing an anionic terdentate (NNC) ligand. Substitution of Cl$^-$ of (**2a**) with anionic ligands I$^-$ and CF$_3$CO$_2^-$ yielded (**2b**) and (**2c**), respectively. Reaction of (**2a**) with HC≡CC$_6$H$_4$Bu^t-4 afforded the red Pt(II) acetylide (**3**). Treatment of (**2a**) with 0.5 equivalent of [(η^3-methallyl)Pd(μ-Cl)]$_2$ and NH$_4$PF$_6$ resulted in forming the salt (**4**). Substitution of Cl$^-$ of (**2a**) with neutral ligands such as PPh$_3$ and 4-dimetylaminopyridine (DMAP) gave rise to salts (**5a**) and (**5b**), respectively.

Keywords: Pt(II) complexes, pyridyl ligand, fluoranthene, cyclometallation and substitution

*Corresponding author: ksper@ou.ac.lk

Aqueous phosphate removal behavior of chemically synthesized vaterite nanoparticles: Isotherms and kinetic study

Senarathna D.D.T.D.[1]*, Rajapakse R.M.G.[2], Abeysooriya K.H.D.N.[2] and Wijenayake W.M.H.K.[1]

[1]*Department of Aquaculture and Fisheries, Faculty of Livestock Fisheries and Nutrition, Wayamba University of Sri Lanka, Makadura, Gonawila (NWP), Sri Lanka*
[2]*Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka*

Eutrophication is one of the most adverse impacts of nutrient contamination of water bodies. Recent studies have shown that the primary limiting factor for eutrophication is phosphorus. We developed a vaterite polymorph of porous calcium carbonate nanoparticle to remove phosphate ions in water. These nanoparticles were synthesized using calcium acetate and sodium bicarbonate in a water-ethylene glycol media at a temperature of 100°C in a reaction time of 24 hours and characterized by the X-Ray Diffraction and the Fourier transform infrared spectroscopy which show the presence of vaterite. Particle size was 25.5 nm, and the Scanning Electron Microscopy coupled with Energy Dispersive X-Ray Analysis show the spherical vaterite nanoparticles and the presence of calcium, carbon and oxygen. The phosphate removal efficiency was tested with different concentrations of phosphate solutions (2 ppm – 80 ppm), pH levels (5 – 12), adsorbent dosages (0.05 g – 0.25g), and contact times (0 – 120 min). Ion chromatography was used to analyze phosphate in water samples. The maximum adsorption percentage of 100% was obtained with 50 mL of 2 mgL^{-1} phosphate solution and 0.15 g of the synthesized nanoparticle. Adsorption data were well fitted with the Langmuir adsorption isotherm model and the pseudo-second-order kinetic model with R^2 of 0.99 and 0.98 (Rate constant - 0.083 gg^{-1}min^{-1}), respectively. Phosphate adsorption is not influenced in the presence of F$^-$, NO_3^- and SO_4^{-2} as phosphate shows 100% removal in the presence of them. The study presents a viable option for removing excess phosphate and controlling eutrophication.

Keywords: adsorption, phosphate, nanoparticle and removal efficiency

*Corresponding author: trishansenarathna@gmail.com

Antioxidant capacity and constituents of the methanolic extract of *Phyllanthus maderaspatensis* L.

Ranasinghe C.[1]*, Dissanayke D.M.L.C.[2], Weerakoon S.R.[2], Somaratne S.[2] and Nilakarawasam N.[3]

[1]Department of Chemistry, The Open University of Sri Lanka, Nawala, Nugegoda
[2]Department of Botany, The Open University of Sri Lanka, Nawala, Nugegoda
[3]Department of Zoology, The Open University of Sri Lanka, Nawala, Nugegoda

The present investigation was done to evaluate the antioxidant capacity of the methanolic extract of the plant, *Phyllanthus maderaspatensis* (Family Phyllanthaceae) and to identify the major constituents in it. Methanolic extract of *P. maderaspatensis* was found to possess anti-hypercholesterolemic activity on rat model. Hypercholesterolemia can increase oxidative stress in human body. Plant antioxidants are known to reduce oxidative stress by quenching free radicals. Therefore, in order to support to the anti-hyperholesterolimc effect of the methanolic extract *P. maderaspatensis,* antioxidant capacity was assessed by FRAP (Ferric Reducing Antioxidant Power) and ABTS (2,2-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) assays. According to the FRAP assay, antioxidant capacity of the extract was 1.61 ± 0.00 mM Fe^{2+} per gram of dry weight of the extract while it was 84.46 ± 0.09 mM Trolox Equivalents per gram of dry weight according to ABTS assay. Analysis of the methanolic extract of *P. maderaspatensis* by LC-HRESIMS and dereplication with SciFinder and Dictionary of Natural Products, revealed the presence of chelonanthoside, chlorantholide E, erythrinacinate C, calocedimer A and methyl-6-O-[2,3,4-tris-O-(2,2-dimethylpropanoyl)-6-methyl-β-D-glucopyranuronosyl]-β-D-galactopyranoside as some major constituents in it.

Keywords: Phyllanthaceae, *Phyllanthus maderaspatensis*, antioxidant capacity, anti-hypercholesterolemic activity and LC-HRESIMS

*Corresponding author: crana@ou.ac.lk

Analysis of polycyclic aromatic hydrocarbons in dried black tea

Sithara T.A.H.[1]*, Marapana R.A.U.J.[1], Liyanage R.[2] and Senanayaka S.[1]

[1]Department of Food science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka
[2]Department of Bio Systems Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Polycyclic Aromatic Hydrocarbons (PAHs) are omnipresent organic compounds containing two or more condensed aromatic carbon rings; generated by incomplete combustion of organic molecules. During food preparation, processing or from the environment, food can be contaminated from PAHs. Since this is an untouched area for black tea in Sri Lanka, this study was carried out using same grade, dried black tea samples, collected from seven tea factories according to the two dryer types, which are steam furnace and firewood furnace, to investigate the occurrence and to analyze the quantity of 16 PAHs. The Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) method used to prepare samples and the analysis has done by using the Gas Chromatography Mass Spectroscopy (GCMS) technique. The dried black tea samples from firewood furnace has higher total PAHs content than ($P<0.05$) steam dried. The total PAHs content in dried black tea samples were 38335.45, 26222.40, 27344.91, 10895.08, 11142.79, 11143.23 and 16726.77 µg/kg respectively. The dried black tea samples were contained two and three rings PAHs than five and six rings PAHs. According to the International Agency for Research on Cancer, the lower molecular weight PAHs are not a considerable threat to human health. Since, PAHs are lipophilic, their transferring rate to tea infusion is very low. Therefore, consumption of black tea is safe to human health.

Keywords: dried black tea, GCMS, PAH and quechers method

*Corresponding author: hasinisithara93@gmail.com

Faculty of Science
University of Ruhuna

RISTCON
2020

Maturity dependence of chemical constituents in bark and leaf oil of two varieties of Ceylon cinnamon (*Cinnamomum zeylanicum* Blume)

Wijeweera A.A.[1], Hewage J.W.[2]*, Jayasinghe G.G.[1], Hemalika W.S.[2], Hettiarachchi S.R.[3] and Wijesinghe K.G.[1]

[1]*National Cinnamon Research and Training Center, Department of Export Agriculture, Sri Lanka*
[2]*Department of Chemistry, University of Ruhuna, Sri Lanka*
[3]*Department of Chemistry, The Open University of Sri Lanka*

The maturity dependence of chemical constituents in bark and leaf oils of two varieties of Ceylon Cinnamon, *Cinnamomum zeylanicum*, was studied. We maintained both genetic factor and ecological factor constant by using two varieties of Ceylon Cinnamon, Sri Gamunu and Sri Vijaya, which were vegetatively cultivated, and planted in the field in the same agro-ecological zone, IL1a ($6^0 1.7820$N'; $80^0 33.4990$'E; 22.3 amsl.). Three maturity stages of cinnamon plants, i.e. more than 5 years, between 2-2.5 years, and between 1.5-2 years, were used. Each data was statistically treated with 10 replicates. When compared the oil contents, Sri Gamunu had a higher oil yield in both the bark and leaf (2.33% and 3.7%, respectively) than Sri Vijaya (1.38%, 2.41%), and also both showed significantly higher oil yields at maturity stage of 2-2.5 years which was about the customarily identified maturity for harvesting (~2 years). In Sri Gamunu, about 78 % of the bark oil consisted of cinnamaldehyde and cinnamyl acetate while those two chemical constituents in Sri Vijaya accounted for only about 63%, but consisted of a higher content of eugenol (12%) and benzyl benzoate (9%). In contrast to the bark oil, eugenol was the major component in leaf oil of cinnamon, which accounted for about 80 % and 87% in Sri Gamunu and Sri Vijaya, respectively. The study revealed that the best maturity stage to harvest both varieties of cinnamon is 2 – 2.5 years of maturity for maximum chemical constituents in bark and leaf oils.

Keywords: cinnamon, cinnamon bark oil, cinnamon leaf oil, cinnamaldehyde and cinnamon maturity

*Corresponding author: jinasnea@chem.ruh.ac.lk

Removal of calcium ions in aqueous solutions by modified *Moringaoleifera* fruit coat

Dahanayaka H.S. and Prabagar J.*

Department of Chemistry, University of Jaffna, Jaffna, Sri Lanka

In this study, removal of calcium ions in aqueous solutions by modified *Moringa oleifera* (MO) fruit coat was carried out. Different particle sizes (62 µm-2000 µm) of MO were taken and tested for their efficiency on adsorption with different dosages on removal of calcium ions of different concentrations. Before the modification of MO, experiment was conducted with the calcium ion solution and unmodified MO fruit coat and results showed that Ca ions were released from the fruit coat material. For the modification process dried MO fruit coat were treated with 1 moldm^{-3} NaOH. The effect of experimental conditions such as the particle size of the MO fruit coat, initial pH of the solution, the dosage of MO, initial metal ion concentration were investigated. Results showed that the maximum adsorption capacity of 95.18% was observed at pH 7 with 2 g of dosage of MO in the particle size range of 149 µm-177 µm. The adsorption was tested by fitting the adsorption data with Langmuir isotherm and Freundlich model. It was found that the adsorption of Ca^{2+} on MO fruit coat obeys the Langmuir model. The maximum adsorption capacity of Ca metal ion by using modified MO fruit coat was 6.144 mgg^{-1}. These findings suggest that modified MO fruit coat has high biosorption activity for the removal of calcium ions in aqueous solutions.

Keywords: adsorption process, biosorbent, *Moringa oleifera*, Langmuir isotherm and Freundlich model

*Corresponding author: j_prabagar@yahoo.co.uk

Biosynthesis of ZnO nanoparticles by leaf extract of *Plumeria* and characterization

Halanayake K.D., Kalutharage N.K.* and Hewage J.W.

Department of Chemistry, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Green synthesis of metal oxide nanoparticles using plant extract is a promising alternative to traditional method of chemical synthesis. It is one of the best ways to control different sizes of nanoparticles. In this context, we report the synthesis of ZnO nanoparticles by biological method using *Plumeria* plant extract. ZnO nanoparticles were synthesized using $Zn(CH_3COO)_2$ and Plumeria leaf extract as the solvent. ZnO nanoparticles were characterized by UV-visible spectroscopy, Powder X-ray diffraction (PXRD), Fourier Transform Infrared spectroscopy (FT-IR) techniques. UV-visible spectroscopic analysis indicates that the maximum absorption peak at 356.0 nm corresponding to the characteristic band of ZnO nanoparticles. Peaks at 544 cm^{-1} and 545 cm^{-1} in IR spectrum indicate the characteristic absorption of Zn-O bond for the biosynthesised ZnO nanoparticles with 1 mL and 20 mL of plant extracts respectively. PXRD pattern shows 2θ values at 31.71˚, 34.39˚, 36.24˚, 47.52˚, 56.56˚, 62.86˚, 67.91˚ and 69.02˚ which could be indexed as the ZnO - wurtzite structure. Further, the average crystallite size was estimated as of 27.23 nm for ZnO nanoparticles by using Debye Sherrer's formula.

Keywords: ZnO, biosynthesis, nanoparticles, absorption and diffraction

*Corresponding author: knishantha@chem.ruh.ac.lk

RISTCON
Faculty of Science
University of Ruhuna
2020

Decolourization of textile dyes by fenton-like reaction with iron impregnated biochar catalyst from bamboo (*Bambusa vulgaris*)

Gedara Wattage N.T.D., Kalutharage N.K., Ganaga Badage C.S. and Wanniarachchi S.*

Department of Chemistry, University of Ruhuna, Matara

Treatment of textile wastewater containing reactive dyes is highly important as dyes and their breakdown products are toxic. Fenton oxidation is widely used to decolorize textile wastewater. Formation of Iron containing sludge and the requirement of an excessive amount of Fe(II) salt are the disadvantages of homogeneous Fenton process. Therefore alternative treatment method is required. In this study, catalytic activity of iron impregnated bamboo biochar as a heterogeneous catalyst for removing reactive Black 5 dye was investigated. Iron impregnated biochar catalyst was successfully prepared and characterized by X-Ray Diffraction (XRD), FT-IR and SEM imaging. SEM images showed comparatively low porosity after the Fe impregnated. The FT-IR spectrum of activated biochar clearly showed a characteristic broad peek at 1010 cm^{-1} which was assigned to PO_4^{3-} stretching. An iron loading of 0.85 wt% on activated bio-char was achieved in the catalytic preparation. Decolourization studies were performed with bamboo biochar, activated bamboo biochar, iron impregnated bamboo biochar and the results were compared. Optimum Fenton reaction conditions for the decolourization of 100 mL of 100 ppm RB5 solution was determined as 0.5 g of the catalyst with an initial pH of 3.0, [H_2O_2] of 6.42 mM at 30 $^{\circ}$C. Under these conditions, 90.8% colour reduction and 55.2% COD reduction was achieved within 60 min reaction time. Re-usage studies showed the applicability of the catalyst over 5 cycles with more than 80% colour reduction. Results of the current study indicate the suitability of bamboo biochar catalytic system as a heterogeneous catalyst for decolourization of RB5 in textile wastewater.

Keywords: Fenton reaction, Heterogeneous catalyst, Iron impregnated bamboo biochar and RB5

*Corresponding author: sarathwan@chem.ruh.ac.lk

Is the long-term exposure to trace elements and fluoride the main factor for the prevalence of CKDu?

Perera W.P.R.T.*, Dayananda M.D.N.R., Botheju W.S.M. and Liyanage J.A.

Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka

Toxin-mediated renal failure may extensively contribute to the increase of the prevalence of Chronic Kidney Disease of unknown etiology (CKDu) in the North Central Province, Sri Lanka. Long term exposure to Fluoride and toxic trace elements have been revealed as contributing risk factors for the cause of chronic renal damages. Therefore, this study determined Fluoride and toxic trace elements in drinking water of dug wells and tube wells in Dimbulagala Grama Niladahari Division (GND) (CKDu hotspot), Polonnaruwa, Sri Lanka. Triplicated 30 water samples were collected from fifteen dug-wells and fifteen tube-wells and on-site measurements; conductivity, dissolved oxygen and pH were recorded. Trace elements and Fluoride concentrations were analyzed using Inductive Coupled Plasma Mass Spectrometry and Ion Chromatography respectively. Results were statistically analyzed by MINITAB software. According to the obtained results, mean fluoride content in tube-wells was complied with the SLS standards (0.81 mg/L) and mean fluoride level in dug-wells was 1.59 mg/L, which exceeding SLS drinking water quality standards (1.0 mg/L). Fluoride contents in dug well water were significantly higher than tube well waters (p = 0.007). Furthermore, analyzed nephrotoxicants in tube wells such as Cr (0.789ppb), Cd (0.020ppb), Pb(0.545ppb),and As (0.119ppb) and that were in dug wells including Cr(0.353ppb), Cd(0.07ppb), Pb(0.415ppb) and As(0.400ppb) did not exceed the SLS permissible limits. The calculated water quality index for tube-well water was 55.3, which indicates poor water quality according to the classification of weighted arithmetic method. Hence, it can be concluded that long-term exposure to fluoride and trace elements via drinking water may be one of the main risk factors for chronic renal failures such as CKDu.

Keywords: Risk factors, fluoride, nephrotoxic trace elements and water quality index

*Corresponding author: 2017_perera@kln.ac.lk

Assessment of airborne emission and impact reduction potentials from Norochcholei coal power plant

Senadeera K.R., Adikari P.D. and Rathnayake M.*

Department of Chemical and Process Engineering, University of Moratuwa, Sri Lanka

Despite the social resistances due to environmental consequences, Lakvijaya coal power plant, Norochcholai (LCPP) contributes for over 35% of national grid electricity in Sri Lanka. However, a quantitative emissions inventory and associated environmental impacts from LCPP have not been made publicly available. Hence, the objective of this study is to theoretically evaluate airborne emissions and associated environmental impacts from LCPP using a standard environmental impact assessment method. The results reveal that uncontrolled hourly airborne emission rates from LCPP are approximately 223.5 tonnes of CO_2, 2.6 tonnes of SO_2, 1.42 tonnes NO_x, and 30 tonnes of particulate matter. Three scenarios were compared for environmental impacts: with uncontrolled emissions (S1), emissions with current control techniques (S2), and emissions with proposed control techniques (S3). Impact results in the S1 are, climate change (745.16 kg CO_2,eq/MWh), terrestrial acidification (11.34 kg SO_2,eq/MWh), photochemical oxidant formation (5.44 kg NMVOC/MWh), and particulate matter formation (103.28 kg PM_{10},eq/MWh). Airborne emission levels and corresponding environmental impact reduction potentials in three scenarios were compared and discussed. The study would facilitate decision and policy making to mitigate future environmental impacts.

Keywords: airborne emissions, environmental impacts, impact reduction potentials and coal power plant

*Corresponding author: mratnayake@uom.lk

Faculty of Science
University of Ruhuna

RISTCON
2020

Fungal laccase activity on degradation of CI Direct Blue 201 textile dye

Ekanayake E.M.M.S.[1], Udayanga D.[2], Wijesekara I.[3] and Manage P.M.[1]*

[1]*Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, 10250, Sri Lanka*
[2]*Department of Bioystems Technology, Faculty of Technology, University of Sri Jayewardenepura, 10250, Sri Lanka*
[3]*Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, 10250, Sri Lanka*

Textile dye effluent is one of the most toxic effluents released to the environment. Laccase enzyme has potential to degrade wide range of organic pollutants including textile dyes. Therefore, present study was designed to evaluate the potential applicability of crude laccase enzyme extracted from fungal strain; *Curvularia* sp., a previously identified laccase producing fungi, for decolorization of CI Direct Blue 201 (DB) textile dye. The *Curvularia* sp. was grown on rice grains with 50 mg/L DB dye, crude laccase enzyme was extracted to 50 mM of cold potassium phosphate buffer and partially purified by ammonium sulphate precipitation following dialyzing against the same buffer at 24 °C. A 5% of the extracted crude enzyme (120 U/ml of laccase) was added into 50 mg/L of DB dye (pH 7) and decolorization was observed by measuring the changes of the absorbance at 570 nm, using UV-Visible spectrophotometer. The laccase activity was determined measuring the 2,20-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) oxidation at 420 nm ($\varepsilon_{420} = 36000$ M^{-1} cm^{-1}). In the present study, 78% decolorization of dye was detected at 9 hrs of incubation at room temperature while control remained without detectable color change. The activity of the laccase enzyme before and after the dye decolorization was 120 (U/ml) and 55 (U/ml), respectively. The changes of the FTIR spectra indicated degradation of DB dye following the enzyme treatment. Thus, laccase enzyme, extracted from *Curvularia* sp., can be used as potential enzyme for removal of textile dye and further optimizations are required to enhance the decolorization process.

Keywords: textile dye, CI Direct Blue 201, decolorization, *Curvularia* sp. and laccase enzyme

*Corresponding author: pathmalal@sjp.ac.lk

Faculty of Science
University of Ruhuna

RISTCON
2020

Effect of salinity in altering microbial biomass carbon at saltmarsh ecosystems at Mannar region, Sri Lanka

Dissanayake D.D.M.O.[1], Jayasinghe J.A.V.R.[1], Perera G.A.D.[2], Kadupitiya H.K.[3], Seneweera S.[1] and Ratnayake R.R.[1]*

[1]National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Natural Resources Management Centre, Peradeniya, Sri Lanka

Saltmarshes are transitional habitats located between the ocean and land, which are inundated by daily, or occasional flooding of saltwater brought in by the tides. Despite the ecosystem's high productivity and potentiality in soil Carbon (C) sequestration, it is the most understudied and poorly conserved ecosystem of all Blue Carbon ecosystems. Therefore, a study on Soil Organic Carbon (SOC) and Microbial Biomass Carbon (MBC) of saltmarsh ecosystems located at Mannar South bar and Vankalei (West coast of Mannar) was conducted. Random sampling was done from the top layer of soil (0-15 cm from surface) using an auger. Soil Electrical Conductivity (EC), pH, MBC and SOC were measured and analyzed using MINITAB 17. The pH was around at highly basic levels of 8.4 and other variables varied from and up to 0.76-11.25 mS/cm, 0-1.6%, and 0.008- 1.4%, respectively. Cluster analysis of variables revealed a riveting positive correlation between EC and MBC (r= 0.7). However, a similar correlation was not observed between EC and SOC. Simultaneously, general MANOVA was performed, which resulted in a significant difference ($p<0.05$) at MBC with respect to soil salinity gradient. Therefore, we can conclude that soil microbial communities get affected by salinity. Thus, enzyme activity in the soil microbial of salt marsh has not been inhibited despite the high ionic conductivities. Though the effect of EC on SOC was faint therefore, developmental activities around salt marshes should be properly managed in order to conserve these ecosystems.

Keywords: saltmarsh and microbial biomass carbon

*Corresponding author: renukaratnayake12@gmail.com

Determination of tributyltin in marine water and sediment in commercial and fishery harbors

Bandara K.R.V.[1], Chinthaka S.D.M.[2] and Manage P.M.[1]*

[1]Center for Water quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Department of chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Tributyltin (TBT) is a ubiquitous contaminant in the aquatic environment which used as an active ingredient for biocides, antifouling paints and wood preservatives in industrial sector. According to their high lipophilic strength, TBT accumulate in fat tissues of wild life via the environment food chains. Their high biocides activity leads to impairments and malformations of endocrine system and sex changes in affected aquatic organisms. Leading to collapse of faunal diversity in the aquatic ecosystem. Therefore, monitoring TBT contamination is important to understand the level of contamination in Sri Lanka thus to prepare management protocols to protect aquatic environment. In present study, novel modified method from Solid Phase Micro Extraction (SPME) method was used to extract TBT from the environmental samples and quantification was done using the Gas Chromatography Mass Spectrometry (GC-MS). Water and sediment samples from Colombo, Galle, Hambanthota and Trincomalee commercial harbors and Dikkowita, Beruwala, Ambalangoda, Galle, Mirissa, Dewundara, Kudawella, Hambanthota, Kirinda and Trincomalee fishing harbors were collected (samples were collected from three locations in each site). Results of the study showed that over 60% of the sampling locations were contaminated with TBT and the concentrations were exceeded the threshold concentration given for wildlife and human beings by WHO (5-10 ng/L). TBT concentrations in water collected from commercial and fishery harbors were ranged from 25±4.2 ng/L to 303±7.4 ng/L whereas in sediments those were ranged from 17± 1.4 ng/g to 107±4.1 ng/g respectively. The highest TBT concentration for both water and sediment were recorded in Colombo harbor which is the largest and the busiest port in Sri Lanka. It was found that the TBT concentration in water was greater than the sediment. Thus, ship/boat traffic zones may responsible sources for the TBT input into environment which follow potential exposure to TBT via consumption of TBT contaminated sea foods which pose human health risks as well.

Keywords: Tributyltin (TBT), fishing harbor, sediment, seawater, Solid Phase Micro Extraction (SPME) and biocides

*Corresponding author: Pathmalal@sjp.ac.lk

RISTCON
2020

Faculty of Science
University of Ruhuna

Cyanotoxin contamination in rice grains (*Oryza sativa*) in two areas where CKDu is highly prevalent and less prevalent in Anuradhapura district, Sri Lanka

Abeysiri H.A.S.N.[1], Wanigasuriya K.[2] and Manage P.M.[1]*

[1]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Sri Lanka
[2]Centre for Kidney Research, Department of Medicine, University of Sri Jayewardenepura, Sri Lanka

Toxigenic cyanobacteria are well known for their ability to produce cyanotoxins such as Cylindrospermopsin (CYN) and Microcystin-LR (MC-LR). Irrigation with cyanobacteria contaminated water containing CYN and MC-LR poses a potential risk of accumulation of cyanotoxins in crops. Cyanotoxin is considered as one of the risk factors for CKDu in Sri Lanka. The aim of the present study was to find the accumulation status of MC-LR and CYN in *Oryza sativa* grains and thus, 184 rice grain samples were collected from CKDu high-prevalent Padaviya (84) and low-prevalent Rajanganaya (Thulana-(33), Yaya 17-(18)), Galnewa (49) to determine CYN and MC-LR. The collected samples were subjected to quantification of CYN and MC-LR using PDA-HPLC. *O. sativa* grains from Padaviya recorded a CYN range of 80 ± 0.08µg/kg to 445 ± 34µg/kg and MC-LR range of 50 ± 0.05µg/kg to 160 ± 21µg/kg and from Rajanganaya, Galnewa were 20 ± 0.01µg/kg to 190 ± 34µg/kg and 30 ± 0.02µg/kg to 80 ± 14µg/kg respectively. The study showed that the potential exposure for humans consuming ~300g of rice per day from Padaviya (MC-LR, 0.09 µgkg^{-1}day^{-1} and CYN, 0.06 µgkg^{-1}day^{-1}), Rajanganaya (MC-LR, 0.02 µgkg^{-1}day^{-1} and CYN, 0.003 µgkg^{-1}day^{-1}) and Galnewa (MC-LR, 0.04 µgkg^{-1}day^{-1} and CYN, 0.01 µgkg^{-1}day^{-1}). The level of mean concentration of MC-LR and CYN in *O. sativa* grains collected from three areas were significantly different from each other following Padaviya (ANOVA, *p<0.05*), Rajanganya (ANOVA, *p<0.05*) and Galnewa (ANOVA, *p<0.05*). Thus, the results of the present study revealed that CYN and MC-LR contaminated *Oryza sativa* has a great potential risk on accumulation of CYN and MC-LR in human body.

Keywords: Cylindrospermopsin (CYN), Microcystin-LR (MC-LR), *Oryza sativa*, CKDu and HPLC

*Corresponding author: pathmalal@sjp.ac.lk

Microbiology as a viable fix for drinking water taste and odour issue; degradation of Geosmin using novel bacteria

Ganegoda S.S. and Manage P.M.*

Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Gangodawila, Nugegoda, 10250, Sri Lanka

Presence of adverse taste and odour (T&O) in treated drinking water is one of the major issues in global drinking water suppliers. Geosmin (*trans-1, 10-dimethyl-trans-9-decalol*) is responsible for earthy taste and odour in drinking water. Despite of no recorded health hazards, Geosmin becomes a major reason for customer rejection of drinking water. Therefore, removing Geosmin from drinking water is a necessity. Biodegradation of Geosmin using native bacteria has been proved compelling. Hence, the current study was designed to determine biodegradation capability of Geosmin using native bacteria. Isolation of Geosmin degrading bacteria in water and in sediment were carried out using standard enrichment study and potential degraders were screened using the Biolog MT2 plate assay. The selected Geosmin degraders were subjected to degradation kinetics study and molecular identification was carried out using 16S rRNA gene sequencing using V3-V4 variable region analysis. *Bacillus cereus* (MK968363), *Bacillus subtilis* (MK 982381), *Acinetobacter guillouisae* (MK968347), *Acinetobacter indicus* (MK972672), *Pseudomonas stutzeri* (MK968348), *Myroides xuanwuensis* (MK606113*), Proteus mirabilis* (MK601699), *Providencia vermicola* (MK 601700), *Providencia rettgeri* (MK968362) and *Myroides odoratitimus* (MK601701) were identified as degrading Geosmin within 7 days whereas *B. cereus* completely degraded Geosmin within 24 hours. Both *B. subtilis* and *A. guillouisae* completely degraded Geosmin at 2 days. Moreover, both *P. mirabilis* and *A. indicus* completely degraded Geosmin at 5 days. The results revealed that degradation mechanism belonged to both pseudo first order and pseudo zeroth orders.

Keywords: Biodegradation, Geosmin, order, native and green

*Corresponding author: jagathj@sci.sjp.ac.lk

Faculty of Science
University of Ruhuna

R STCON
2020

A preliminary investigation of coating properties of different ratios of palm: soy oil-based alkyd: epoxy resins

Panamgama L.A.*, Hewage J.S. and Rathnayaka M.I.V.R.

Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

The purpose of this research was to develop polyalkyds from readily available, low-cost sustainable raw materials by alcoholysis-polyesterification method at lab scale. Palm alkyds has non-self-drying characteristics, therefore 30:70 wt% palm-soy oil blend was polymerized to incorporate more unsaturation into the main alkyd chains. 30:70 wt% palm-soy oil blend was dehydrated with the aim of increasing the degree of unsaturation. The variation of physico-chemical properties of dehydrated oil blend such as acid value, saponification value, iodine value and fatty acid composition were determined. Three types of alkyd resin formulations were developed by varying different parameters such as phthalic anhydride, glycerol and reaction time at 240 ^{0}C. Physico-chemico-mechanical properties of the prepared alkyd resins like acid value, viscosity, saponification value, volatile matter, etc. were evaluated. A series of alkyd/epoxy co-blends were prepared with 80:20, 70:30, 60:40 and 50:50 by wt% ratio of alkyd: epoxy with the aim of assessing their coating characteristics. The structural elucidation of raw materials and their copolymer blends was performed using spectroscopic techniques, while coating and drying properties were evaluated by performance tests on application to glass substrates, which have cured either by UV irradiation or baking. The drying time of coatings cured at temperatures varied from 10 to 180 min at 140-180 ^{0}C range. All of the epoxy-alkyd coatings were light to dark yellowish in colour. Film properties such as swelling ratio, gel content, water, chemical resistance, wettability, chemical resistivity, pencil hardness and surface morphology were investigated. It could prove that blending has resulted a dramatic improvement in coating characteristics of alkyd resins comparative to virgin alkyds. Further this is green technology and potentially suitable to consume renewable resource materials in surface coatings with the benefit of minimizing petroleum-based materials.

Keywords: palm: soy oil, alkyds, surface coatings, FTIR studies and films

*Corresponding author: asoka@chem.ruh.ac.lk

Faculty of Science
University of Ruhuna

R STCON
2020

Bioremediation potential of *Aspergillus fumigatus* to restore some sites contaminated by used lubricating oil

Wijesooriya M.M.[1], Masakorala K.[2]*, Widana Gamage S.M.K.[2], Jayalal R.G.U.[1] and Walakulu Gamage S.S.[2]

[1]*Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, 70140, Sri Lanka*
[2]*Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka*

Soil contamination with used lubricating oil (ULO) due to anthropogenic activities has become an emerging global environmental issue. Since ULO contains hazardous organic compounds and heavy metals, remediation of ULO contaminated sites is vitally important to ensure environmental and human wellbeing. Bioremediation is a green technological approach that has high potential to be applied as a remediation method for ULO contaminated soils. However, its successfulness depends on the ULO degradation potential of the employed microorganism/s. Therefore, present study aimed to describe isolation, identification, and characterization of a ULO degrading fungi that naturally inhabit ULO contaminated soil as an initial step in the development of microorganism-mediated bioremediation technique. A soil sample exposed to ULO contamination for a long time was collected from the service station of Sri Lanka Transportation Board (SLTB) bus depot in Matara. Total petroleum hydrocarbon content in the collected soil sample estimated by using a gravimetric method was 70100 mg kg^{-1} (7.01% w/w). Potential ULO degrading fungi were isolated by enrichment culture in mineral salt medium (MS). The ULO degradation potential of fungal isolate was further confirmed by assessing culture characteristics such as radial extension of mycelia, sporulation, pigmentation, and formation of clear zones on MS agar medium coated with 1% w/v ULO. Fungal isolate provisionally identified as *Aspergillus* spp. by using morphological characters and was confirmed as *Aspergillus fumigatus* by sequencing of 16S rDNA. The sequence was deposited in the GenBank database under the accession no MK949124. The results of the microcosm studies showed the biodegradation percentage of the isolate after 35 days of inoculation at 1-5% w/w ULO were 70.09%, 60%, 54.17%, 50.25%, and 49.12% respectively. Therefore, the overall results highlight the potential of *A. fumigatus* isolate to be used in the bioremediation of ULO contaminated soils.

Keywords: bioremediation, biodegradation, used lubricating oil and *Aspergillus fumigatus*

*Corresponding author: masakorala12@yahoo.com

Production of biodiesel at room temperature from waste cooking oil

Ramaraj N.[1], Weerasiri K.[1] and Pathirana H.M. K. K.[2]*

[1]College of Chemical Sciences, Institute of Chemistry Ceylon, Adamantane House, Rajagiriya, Sri lanka
[2]Department of Chemistry, University of Ruhuna, Matara, Sri Lanka

Introduction of alternative energy sources which are environmental friendly and renewable is required to solve the problem of limited availability of fossil fuels and their negative impacts on the environment. Biodiesel has been identified as a potential alternative for petrodiesel. Biodiesel is a mixture of alkyl esters of long chain fatty acids and commonly used method for industrial production is transesterification of triglycerides in refined vegetable oils. However, the price of biodiesel is higher than petrodiesel due to high production cost. Therefore, the objective of the present work was to develop a low-cost method to produce biodiesel. Waste cooking oil (WCO) which does not have an economic value was used as the feed stock. Miscibility of reactants was increased by using acetone as the co-solvent and this resulted transesterification at room temperature. Because of the high free fatty acid content (0.52 %) in WCO, acid-catalyzed (Methanol, conc.H_2SO_4) esterification was done prior to base-catalyzed (Na, MeOH) transesterification. Water treated bentonite clay showed a potential for refining of biodiesel. Under the best conditions (oil: methanol 1:9 molar ratio, acetone 25 % w/w, reaction period 2h.), the yield was 86.5 %. Fatty acid profile (oleic acid 43.6 %, palmitic acid 37.4%, linoleic acid 11.2% and stearic acid 4.4 %) was compatible with reported data for biodiesel from soya bean oil and palm oil. Further, the density (897 kgm^{-3}), kinematic viscosity (5.3 mm^2s^{-1} at 40 ^{0}C) and flash point (196°C) of biodiesel satisfied the ASTM standards. Hence, this study proves that low cost, good quality biodiesel can be produced from waste cooking oil adopting the proposed method.

Keywords: biodiesel, fatty acid profile, transesterification and waste cooking oil

*Corresponding author: hemap@chem.ruh.ac.lk

Green synthesis of ZnO and Cu-doped ZnO nanoparticles and investigation of their photodegradation ability for textile dyes

Sujani I.W.A.[1], Edussuriya M.[1]* and Dissanayake. A.S.[2]

[1]Department of Chemistry, University of Ruhuna, Matara, Sri Lanka
[2]Department of Pharmacy, University of Ruhuna, Matara, Sri Lanka

This work describes the synthesis of ZnO and Cu-doped ZnO nanoparticles using aqueous extracts of *Oxalis stricta* leaves and the photocatalytic degradation ability of these nanoparticles. Synthesis of ZnO and Cu-doped ZnO nanoparticles was carried out using zinc acetate and copper acetate with aqueous extract of *Oxalis stricta,* which is a natural product with reducing power, inherent stabilizing, growth terminating and capping properties. The nanoparticles were characterized by UV-vis, and X-ray diffraction spectroscopy. Broad absorption bands centered at 368 and 440 nm were observed for ZnO and Cu-doped ZnO nanoparticles respectively. The observed characteristic sharp diffraction peaks for the ZnO naoparticles in the XRD analysis attributed to the hexagonal wurtzite structure for ZnO nanoparticles. Similar XRD pattern was obtained for Cu-doped ZnO indicating no structural changes due to doping with Cu. It was also revealed that not all Cu atoms were embedded to the crystal lattice of zinc oxide. Photocatalytic degradation of three textile dyes, Vat yellow 33, Reactive brown 11 and Reactive green 19 in the presence of synthesized nanoparticles was investigated under different set of conditions. It was found that the synthesized ZnO and Cu-doped ZnO nanoparticles have high photo-catalytic degradation towards common textile dyes. Of these two types of nanoparticles, Cu-doped ZnO nanoparticles exhibited the highest photodegradation activity of 99% for all three textile dyes. This is believed to be due to decreasing of electron-hole recombination rate of ZnO by doped Cu during irradiation. This is further evident from the band gaps found for ZnO (3.36 eV) and Cu-doped ZnO (2.81 eV) nanoparticles formed with *Oxalis stricta* extract. The present study revealed a safer method involving effective use of eco-friendly green synthesized ZnO and Cu-doped ZnO nanoparticles for treatment of waste water contaminated with textile dyes, Vat yellow 33, Reactive brown 11 and Reactive green 19.

Keywords: Oxalis stricta ZnO nanoparticles, Cu-doped ZnO nanoparticles, Photocatalytic degradation and Textile dyes

*Corresponding author: madurani@chem.ruh.ac.lk

Assessment of problematic level of past illicit drug use among male prison inmates in prison, Galle, Sri Lanka using drug abuse screening test-20

Darshana I.L.A.N.[1]*, Ruben R.[2] and Wijesinghe C.J.[1]

[1]*Department of Community Medicine, Faculty of Medicine, University of Ruhuna, Galle*
[2]*Psychiatry Unit, Teaching Hospital, Karapitiya, Galle, Sri Lanka*

Past illicit drug use and drug related offences are becoming an increasingly common problem among prison inmates in Sri Lanka. Identification of problematic drug use at the time of admission helps to deliver comprehensive rehabilitation care for these inmates during imprisonment. This study aimed to assess the problematic level of past illicit drug use among male prison inmates in the prison in Galle. A cross-sectional study was conducted among 449 incarcerated males using the simple random sampling method based on prisoner's register. Prisoners who were diagnosed to have psychiatric illnesses, mentally unsound to respond to the study questionnaires, admitted prior to one year at the time of data collection and female prisoners were excluded from the study. Problematic level of past illicit drug use was assessed using Sinhala and Tamil version of Drug Abuse Screening Test – 20 (DAST 20). Judgmental validity of the questionnaire was assessed by a panel of experts. Levels of problematic drug use was defined according to American Society of Addiction Medicine Placement Criteria. Data was analyzed using SPSS software. The response rate was 98.2% (n=441), and the majority of the participants were residents of Galle district (n=419, 95.0%), Sinhalese (n= 415, 94.1%) and Buddhist (n= 411, 93.2%) with a mean age (± SD) of 33.2 (± 9.5) years. Past illicit drug use was reported among 57.6% (n=254) of the participants. Among them, 8.3% (n=21) had a severe problematic level of illicit drug use, and 27.2% (n=70) reported a substantial level, whereas both of those levels required inpatient rehabilitation care. Prison inmates who were in older (>30 years) age group (p=0.009), who had poly drug use (p<0.001) or were addicted to illicit drugs (p<0.001) were more likely to report problematic use of illicit drugs. A significant amount of prison inmates with history of illicit drug use required inpatient rehabilitation care. A proper system for early identification and referral of these individuals for rehabilitation is recommended to prevent drug related problems in future.

Keywords: drug abuse screening test, inmate welfare and past illicit drug use.

*Corresponding author: ilandare@gmail.com

Prevalence, knowledge and associated factors of anaemia among females aged 15-70 years in a tea estate community in Hantana, Kandy district, Sri Lanka

Sheriff F.A.[1,4], Wijesundara C.R.[2], Chathuranga B.A.G.[3]
and Banadaranayaka K.O.[4]*

[1]Faculty of Health and Life Sciences, Management and Science University, Malaysia
[2]Ministry of Health, Nutrition and Indigenous medicine, Colombo, Sri Lanka
[3]Department of Medical Laboratory Sciences, University of Sri Jayewardenepura
[4]Management and Science Institute, Colombo 03

Anaemia among females remains a major public health concern. The objective of this study was to determine prevalence, knowledge and associated factors of anaemia among females aged 15-70 years in a tea estate community in Hantana, Kandy district. A descriptive cross-sectional study was conducted on 236 randomly selected non-pregnant females who have attained menarche but not yet reached menopausal stage within the estate community. Prevalence of anaemia was determined by measuring haemoglobin (Hb) concentration using an automated blood analyser. Cut-off value for anaemia was set at 12.0 g/dL and categorized into 3 levels: mild (11.00-11.90 g/dL), moderate (8.00-10.90 g/dL) or severe (<8.00 g/dL). Association of anaemia with common risk factors and knowledge regarding anaemia were assessed using a pre-tested self-developed interviewer administered questionnaire. Mean age of the sample was 36 ± 11.7 years and mean Hb value was 12.2 ± 1.42 g/dL. Among participants, the majority were married (85.2%), and had 1-3 children (73.3%). Overall prevalence of anaemia was 33.1% (n=78), among whom mild, moderate and severe anaemia were recorded in 53.8% (n=42), 39.7% (n=31) and 6.4% (n=5) respectively. Anaemia was significantly (p<0.05) associated with being employed (χ^2=9.9), delivered a baby within the past 4 years (χ^2=5.2), advancing age (χ^2=4.9), low income (<20,000 LKR) (χ^2=5.8), prolonged menstrual bleeding for more than 3 days (χ^2=9.7). Majority (58.5%) had poor knowledge with mean score of 5.69 ± 2.42 from a total of 12. As a significant proportion of females in the estate are anaemic with poor knowledge regarding the condition, targeted and culturally appropriate interventions are necessary.

Keywords: anaemia, non-pregnant women and tea-estate community

*Corresponding author: kalpanee.b@gmail.com

Faculty of Science
University of Ruhuna

RISTCON
2020

Relationship between reservoir morphometry and the culture-based fisheries yield of giant freshwater prawn in selected reservoirs of Sri Lanka

Yomal G.A.T.K.[1], Jayasinghe U.A.D.[1]*, Deepananda K.H.M.A.[2]
and Amarasinghe U.S.[3]

[1]*Department of Limnology and Water Technology, University of Ruhuna, Wellamadama, Matara, Sri Lanka*
[2]*Department of Fisheries and Aquaculture, University of Ruhuna, Matara, Sri Lanka*
[3]*Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya, Sri Lanka*

Culture-based fisheries of *Macrobrachium rosenbergii* the giant freshwater prawn (GFP) is being practiced in different reservoirs of Sri Lanka since year 2007, however, no attempts have been made to understand the relationships between varying yield and different limnological conditions in those reservoirs. Therefore, a five-year research project has been started to understand the variations in GFP yield in relation with changing stocking densities, and limnological conditions of the reservoirs. At this initial stage of the project, an attempt was made to correlate the annual total catch (sum of daily capture by the gill net fishers) of GFP with the morphometry of reservoirs being utilized. Reservoir morphometry in terms of shoreline length (m), area at full supply level (ha) and the extent of the littoral zone (m) were estimated in a total of 24 reservoirs located in Hambantota (11) and Monaragala (13) districts using GPS based mapping. Shoreline development index (D_L) and ratio between shoreline length and area (R_{LA}) were calculated using $D_L = L/2 \sqrt{(0.001\pi A)}$ and $R_{LA}=L/A$, respectively. Catch data were collected for year 2019 as a sum of daily capture, from fisheries organizations associated with each reservoir. Stocking data were collected from the records of National Aquaculture Development Authority. Maximum and minimum calculated D_L ranged from 0.08 to 0.30 (mean 0.18 ± 0.01) whilst R_{LA} ranged from 0.02 to 0.14 kmha^{-1} (mean 0.05 ± 0.01). Stocking density of GFP in those reservoirs ranged from 50000- 2003300 PLs. Maximum and minimum yield were 0.13 kgha^{-1} and 4.3 kgha^{-1} from March 2018-March 2019 which the mean $\pm$ SD value was recorded as 1.57 ± 0.22. Extent of the littoral zone varied from 15.77m to 24.10m (mean 19.26 ± 0.49). There was no significant correlation between the GFP yield and the littoral zone extent (r = - 0.033, p>0.05), D_L (r= -0.411; p>0.05) or R_{LA} (r= -0.231). Further data collection on catch per unit fishing effort is necessary to find meaningful relationships between the GFP production and the morphometry of reservoirs being utilized.

Keywords: reservoir morphometry*, Macrobrachium rosenbergii,* littoral extent, shoreline development index and culture-based fisheries

*Corresponding author: asanka@fish.ruh.ac.lk

Knowledge of nurses on peripheral intravascular cannula-site infections and its associated factors

Deepani H.[1], Dharmasena A.W.D.A.[2], Namalee E.A.T.B.[2],
Gunarathna V.G.A.N.[2] and Sriyani K.A.[3]*

[1]*School of Nursing, Colombo, Sri Lanka*
[2]*The National Hospital Sri Lanka, Colombo*
[3]*Department of Nursing, The Open University of Sri Lanka*

Improper Peripheral Intravascular Cannulation (PIC) or maintenance of that would result in peripheral intravascular cannula-site infections (PICI). Since nurses play a key role in insertion, maintenance and removal of PIC, an examination of their knowledge about PICI is important in providing optimal care to patients with PIC. This study is aimed at assessing nurses' knowledge of PICI and to determine its associated factors. This was a descriptive cross-sectional survey conducted from March to June 2019 among 250 nurses employed in medical wards at the National Hospital of Sri Lanka (NHSL). Data were collected using a pre-tested, content-validated, self-reported questionnaire which consists of 20 items divided in to three main domains, namely, cannula insertion, cannula maintenance and prevention of PICI. Nurses who had ≥ 1 year of experience in relevant practice were participated voluntarily after signing informed consents. The response rate was 92.4%. Most of the nurses were females (88.3 %) and were aged between 25-30 years (73.6%). Most of them had 2-5 years of experience in nursing (79.7%) and in medical wards (85.3%). Nurses' overall knowledge on PICI was 47.6 ± 14.8 (range 0-80). The knowledge on cannula insertion, cannula maintenance, and prevention of PICI were 43.9 ± 16.8, 46.5 ± 29.9, 51.9 ± 22.8 respectively. Younger nurses (<30 vs. >30 years) and less experienced (<5 vs. >5 years) nurses in nursing and medical wards, diploma nurses and grade III nurses had significantly higher knowledge on PICI (<0.001). In conclusion, nurses' knowledge on PICI was found to be unsatisfactory. Nurses' knowledge seems to depend on duration of their basic academic qualification and exposure to the service and clinical field. Appropriate in-service educational sessions would be beneficial to refresh and improve their knowledge on PICI.

Keywords: hospital nurses, peripheral intravascular cannulation and infection prevention

*Corresponding author: kasri@ou.ac.lk

Development of herbal face cream with potential radical scavenging activity using *Cassia auriculata, Curcuma longa* and *Aloe barbadensis*

Madushani S.M.S and Hettihewa S.K*

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

The aim of the present study was to formulate a herbal face cream with potential radical scavenging activity using *Cassia auriculata* (Ranawara) (flowers), *Curcuma longa* (Turmeric) (rhizomes) and A*loe barbadensis* (Aloe vera) (leaf) extracts. Aqueous ethanol extracts (70%) of three plants were prepared by steeping method. Ranawara flower extract was subjected to preliminary phytochemical tests. The total phenolic, flavonoid contents and *in vitro* radical scavenging activity of Ranawara flower extract were evaluated by Folin-Ciocalteu assay, aluminium chloride colorimetric method and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay respectively. An herbal face cream was formulated by using the freeze dried powders of plant extracts and evaluated for *in vitro* radical scavenging activity. The phytochemical screening of Ranawara flower extract revealed the presence of phenolic compounds, flavonoids, alkaloids, quinones, reducing sugars, starch, proteins, steroids and saponins and absence of resins. The total phenolic and flavonoid contents of the Ranawara flower extract (mean ± SD) were determined as 9121.778 ± 67.117 mg Gallic acid equivalent (GAE)/100 g dry weight (DW) of flowers and 3868.068 ± 652.961 mg Catechin equivalents (CAE)/100 g DW of flowers. Radical scavenging activity of the Ranawara flower extract was 8.266 ± 1.410 mmol Trolox equivalents/100 g DW of flowers. The results of the radical scavenging activity of formulated cream and commercial cream were determined as 10.595 ± 0.505 and 6.793 ± 0.133 mmol Trolox equivalents/100 g of cream. This cream was found to be homogenous, semi-solid and cream colour having pH 6 to 7. Physical stability parameters showed no remarkable variation during 12-week period. It is concluded that this herbal face cream has promising radical scavenging activity.

Keywords: radical scavenging activity, Ranawara, total flavonoid content, total phenolic content

*Corresponding author: krishanthi2001@yahoo.com

Effect of seaweeds supplemented diets on growth performances of koi carp (*Cyprinus carpio* Linnaeus, 1758) fry in laboratory conditions

Sudharaka K.G.A., Munasinghe D.H.N.*, Guruge W.A.H.P.
and Amarasinghe N.J.De S.

Department of Zoology, University of Ruhuna, Wellamadama, Matara, Sri Lanka

There is a growing trend to use seaweeds as a supplement in fish feed due to its nutritional value, low cost and the availability. The objective of the present study was to determine the effect of two types of seaweed (*Ulva lactuca* and *Sargassum cinereum*) supplemented diets on growth performance of koi carps at their fry stage (birth up to three months). The experimental set up consisted of three treatments with supplemented diets as *U. lactuca* (T_1), *S. cinereum* (T_2) and the Control. Control diet consisted of fishmeal and soya bean (41.57% each), Coconut meal and wheat flour (7.78% each) and vitamin and mineral mixture (1.3%). Crude protein content (CP) of control diet was $36.26\pm0.57\%$. Thirty percent of the weight of control diet was replaced by the *Ulva* and *Sargassum* powder to prepare test diets T_1 and T_2 and the estimated CP of the diets were $24.14\pm0.27\%$ and $21.33\pm0.01\%$ respectively. Fourteen-week indoor experiment was carried out using koi carp fry belonging to the same cohort having mean weight and mean length 2.20 ± 0.08g and 3.89 ± 0.04cm respectively. They were introduced into 150L fiber tanks (n=20 per tank; four replicates per treatment) prepared under 3 treatments; C, T_1 and T_2. The fish were fed 5% of their body weight twice a day (09.00h and 15.00h) for 98 days. The weight measurements were measured once in two weeks. The water quality parameters, i.e., Temperature, pH, Conductivity, Dissolved oxygen, Nitrate and Phosphate concentrations in treatment tanks were measured twice a week during the experiment. Weight Gain (WG), Daily Growth Rate (DGR%), Relative Growth Rate (RGR%), Feed Conversion Ratio (FCR), Feed Conversion Efficiency (FCE%), Specific Growth Rate (SGR) were calculated to evaluate the fish performance due to the consumption of prepared diets and analysis of growth parameters were statistically tested (one-way ANOVA and Tukey test for pair-wise comparisons). At the end of the 14th week of the experiment, mean weight, mean weight gain, daily growth rate values showed significant difference (P< 0.05). Tukey test revealed that FCR of T_2 and T_1 were significantly different (P<0.05) from C, while FCE% of T_2 was significantly different (P<0.05) from C. Out of the two seaweed supplemented diets *Sargassum* supplemented diet has shown better growth performance in koi carp. Water quality parameters did not show significant difference (P>0.05) among treatments. The results showed the potential use of seaweed; *U. lactuca* and *S. cinereum* as a dietary supplement for koi carp at fry stage to obtain better growth performance by developing low-cost diet.

Keywords: koi carp, seaweeds, growth performance, and water quality parameters

*Corresponding author: dhnm@zoo.ruh.ac.lk

Comparison of the effectiveness of free weight squat training and Smith machine squat training on muscle hypertrophy of recreational athletes

Wijerathne P.A.R.C.* and Weerarathna L.R.N.D.*

Department of Sport Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, Sri Lanka

The purpose of this study was to compare the effectiveness of free weight (FW) squat training and Smith machine (SM) squat training for lower limb muscle hypertrophy. Pre- and post-interventional tests were conducted for two treatment groups (FW and SM) separately. Twenty recreational athletes with the mean age of 22.9 years, height 167.4 cm, weight 57 kg and BMI 20 kg/m^2 were recruited to the study using stratified random sampling technique. Equal number of athletes (n=10) were assigned to each group. Individuals on supplements for muscle building or engaged in sports activity were excluded. The baseline values of lower limb segmental muscle mass right (MMR) & left (MML), fat percentage left (FPL) & right (FPR), and fat mass left (FML) & right (FMR) and muscle circumferences (mid-thigh left (MTL) & right (MTR) and calf left (CL) & right (CR)) were measured using Bio Electrical Impedance Analysis and tape measure respectively. Athletes did their exercise 4 sets of six repetitions for 30 minutes, three sessions per week for four weeks. Then the post-interventional tests were conducted. A significant difference was found between SM and FW method in all comparing factors (MMR p<0.0001, MML p<0.0001, FPL p<0.0001, FPR p<0.0001, FML p<0.0001, FMR P=0.038, MTL P<0.0001, CL P<0.0001, and CR P<0.0001). SM training method always gave higher results than FW training method. It can be concluded that SM training method is more effective than FW training method for the muscle hypertrophy.

Keywords: Smith machine, free weight, lower limb and muscle hypertrophy

*Corresponding author: rumeshchanaka7@gmail.com

The effectiveness of buddy strapping vs splinting for treating proximal interphalangeal joint collateral ligament injuries among athletes

Samarathunga S.A.E.K.*, Weerarathna L.R.N.D. and Karunathilake A.

Department of Sport Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya

Proximal Interphalangeal (PIP) joint injuries are common in ball-handling and other contact sports. Splinting and buddy strapping for PIP joint collateral ligament (CL) injuries are the current conservative treatments with possibly different outcomes. This study was aimed to evaluate the effectiveness of splinting Vs buddy strapping for treating PIP joint CL injuries among athletes. Sixteen athletes aged 16-45 years (females n=4 and males n=12) who have had grade I and II injuries within two weeks were recruited for this study. The range of motion (ROM) of the affected finger, pain and a Quick Disability of the Arm, Shoulder and Hand (Quick DASH) score and Visual Analogue Scale (VAS) were assessed as a pre-test, ongoing test (3rd week) and a post-test (6th week) after the injury. The ROM of the PIP joint (P=0.136) did not show a significant difference between two groups. ROM recovered quicker in buddy strapping (mean values pre-21.25, post-97.25) group than splinting group (mean values pre-35, post-107.8). There were improvements of pain perception without movements (mean pre-5.12 post-1.5) and with movements (mean pre-8, post-3.37) in buddy strapping and pain without movements (mean pre-5.12, post-2.62) and pain with movements (mean pre-7.62, post-3.62) in splinting treatment. Buddy strapping for PIP joint CL injuries has shown significant improvement in hand function recovery (P=0.01). The results have shown that the range of motion and pain in both groups recovered gradually over 6 weeks with both treatments and Buddy strapping showed significant speedy recovery among both treatments.

Keywords: proximal interphalangeal joint, collateral ligament, buddy straps, splints, visual analog scale and range of motion

*Corresponding author: erandikumarisamaratunga@gmail.com

Weight reduction behaviours among obese young adults in Colombo district, Sri Lanka

Priyangika K.G.G.[1*], Wasalathanthri S.[2], Jayawardena R.[2] and Hettiarachchi P.[3]

[1]Department of Nursing & Midwifery, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka
[2]Department of Physiology, Faculty of Medicine, University of Colombo, Sri Lanka
[3]Department of Physiology, Faculty of Medicine, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Understanding weight reduction behaviours of obese young adults is helpful in planning weight reduction programmes. This descriptive cross-sectional study assessed the weight reduction behaviours of obese (BMI $\geq 25 \text{kgm}^{-2}$) adults aged 18-35 years (N=261) attending a nutrition clinic of a teaching hospital in Colombo. An interviewer-administered questionnaire validated elsewhere (Iran) was used for data collection after face validation, and Chi-square test was used for comparisons. The majority (86.2% (n=225) has attempted weight reduction at least once. Only 33.8% (n=76) of them have sought professional advice of which all were abdominally obese and 67.1% (n=51) were above the mean age (27.9 years). Statistically significant associations were recorded between the tendency for seeking professional advice and presence of abdominal obesity ($p=0.003$), obesity class ($p<0.001$) and age ($p=0.003$). When weight reduction was considered, diet control alone was used by 39.8% (n=104) , physical activities alone by 6.9% (n=18) and 33.3% (n=87) used both. Lack of motivation (60.9%) was the main reason for discontinuation of previous weight reduction attempts. However, only 41.8% used weight measurement to be aware of their weight. Further, 52.9% of the participants were skipped at least one meal per day and statistically significant associations were seen between meal skipping behaviour and age ($p<0.001$), gender ($p=0.011$) and educational status ($p=0.004$). Only 38.3% of participants have received information on weight reduction through health care professionals. The present study concludes that weight monitoring, participant motivation and involvement of health care professionals as deficient areas in the weight reduction of obese young adults.

Keywords: weight reduction behaviours**,** obesity and young adults

*Corresponding author: gpriyangi1@gmail.com

Foraging niche characteristics of mixed species bird flocks in Horton plains national park

Kalhari K.M.T. and Mahaulpatha W.A.D.*

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

Mixed species flocking behavior is a common phenomenon in tropical and temperate habitats worldwide. Birds in mixed species flocks may benefit directly or indirectly from this association, through increased foraging and reduced predation risk. There is a niche partition among the members of a mixed species flock. Mixed species bird flocks (MSBFs) were observed in the tropical montane cloud forest habitats of Horton Plains National Park (HPNP) from December 2017 to October 2018 by using the line transect method. When MSBF was met, foraging types, methods, substrates, and heights were recorded by scanning the vegetation. Foraging height which each participant occupied was visually estimated. From the sixteen flock participants, nine species were insectivores and only seven species of omnivores followed these flocks. The mean flocking propensity of insectivores (78.50 ± 17.30) was higher than mean propensity value of omnivores (70.84 ± 15.55) without significant difference. Shrub (≤ 3m) and sub-canopy (3.1-6m) layers were the mostly utilized layers by five flocking species. Most number of species utilized the trunk part of a tree as the major substrate (nine species). Both gleaning and probing methods were used by seven species as their major foraging methods and only two species foraged by sallying. Each bird species had different portions of foraging height, foraging substrate and foraging method utilizations. This is an important characteristic feature in MSBFs since occupancy of different foraging types, methods, substrates and height layers by a species can increase their niche breadth and reduce the niche overlap in their foraging behavior.

Keywords: mixed species bird flocks, foraging niche characteristics and Horton plains national park

*Corresponding author: mahaulpatha@sjp.ac.lk

Impact of recreational trails on the diversity of tetrapod vertebrates of trailside habitats within Horton plains national park

Dhananjani D.M.T. and Mahaulpatha W.A.D.*

Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Impact of recreational trails on tetrapod vertebrates of trailside habitats were studied within Horton Plains National Park (HPNP) from December 2017 to October 2018. To determine the impacts of recreational trails on species composition of tetrapod vertebrates, three types of habitats, namely, a cloud forest, aquatic habitats and grasslands were selected. Fixed trail transect was 100m in length, and three 100-meter fixed control transects were placed 200 meters away from the existing recreational trails. Census of tetrapod vertebrates and nest sites present were recorded. Highest species diversity index was recorded along control transects. There was a significant difference in the amphibian diversity index of control and trail transects in aquatic habitats (p<0.05). The presence of trail had not influenced the reptile species diversity significantly in cloud forest and aquatic habitats. There was a significant difference in bird diversity between transects in all habitat types (p<0.05). The mammal species diversity index was not altered significantly in the presence of trail within all three habitats considered (p>0.05). Percentage of nest sites were higher along control transects. The presence of recreational trails within HPNP has negatively affected the species diversity and nest sites. It can be concluded that it is necessary to minimize the number of recreational trail, which are to be constructed for most of the other protected areas of Sri Lanka.

Keywords: species diversity, tetrapod vertebrates, recreational trails and HPNP

*Corresponding author: mahaulpatha@sjp.ac.lk

Analyses of selected stock parameters of *Dasyatis zugei* (Müller & Henle, 1841) in Gulf of Mannar, Sri Lanka

Gayathry L.D.[1]*, Subaha V.[2], Abeygunawardana A.P.[1] and Jayamanne S.C.[1]

[1]Department of Animal Science, Uva Wellassa University, Passara Road, Badulla, Sri Lanka
[2]Department of Fisheries, University of Jaffna, Thirunelvely, Jaffna, Sri Lanka

The pale edged stingray, *Dasyatis zugei* (Müller & Henle, 1841) is one of the major non-target species caught in the bottom-set crab nets used for catching Blue swimming crab (*Portunus pelagicus*) in Gulf of Mannar. Stock assessment of *D. zugei* will be needed to determine management measures to reduce its accidental catch. Hence, this study aimed at estimating the selected stock parameters of *D. zugei* in Gulf of Mannar. In total, 1,404 and 676 individuals were collected from 4.5-5.5-inch mesh-sized crab nets respectively in two landing sites Vankalai and Thalvupadu during September 2018 – July 2019. Disc width of all individuals was measured (mm), body weight was weighed (g) and sex was determined. Sex ratio of catch was 1:1.33 (male: female). Disc width ranged from 115 mm to 272 mm with the mean ($\pm$SD) and median of 174.86 $\pm$ 22.28 mm and 175.00 mm respectively. Disc width-weight relationship showed $\text{Log W} = -1.906 + 0.1347 \log W_D$ for male and $\text{Log W} = -2.774 + 2.286 \log W_D$ for female. The results show negative allometric growth ($b<3$) for both male and female of *D. zugei*. This concludes that *D. zugei* can grow faster in length than in weight. The stock status of *D. zugei* was determined using Length Based Spawning Potential Ratio model available in Barefoot ecologist toolbox and the result shows the Spawning Potential Ratio as 13%. The ratio ranges between 0% - 20%, it indicates that the population is overexploited. Results of the current study suggest that *D. zugei* population in the study area is over exploited. In conclusion, *D. zugei* population in Gulf of Mannar needs to be managed for a sustainable fishery.

Keywords: *Dasyatis zugei,* pale edged stingray, non-target species, stock status and sustainable fishery

*Corresponding author: gayathrydilu93@gmail.com

Evaluating the types of dysphagia among clients diagnosed with Alzheimer's disease in state sector hospital settings in Western province, Sri Lanka

Samanmali M.K.S., Chathurika L.K.E.* and Rathnayaka S.

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Sri Lanka

Alzheimer's disease (AD) associates with Dysphagia and often presenting with common symptoms like pneumonia, malnutrition, dehydration or even death. No previous studies have been done on this area in Sri Lankan (SL) context. Therefore, it is important to evaluate the types of dysphagia among AD in Sri Lanka. A mixed study design was conducted at state sector hospital setting among 40 AD clients (>18 years) with over 6 months of onset. Thirty-four participants (85%) were currently experiencing one or more dysphagia symptoms in pre oral and/or, oral and/or, esophageal stages. There was a significant negative correlation between the age and the severity of swallowing (r_s = -0.06, p<0.001). Severity of swallowing with stages of swallowing (r = -0.601, pre-oral; r = -0.713, oro-pharyngeal) showed significant negative correlation (p<0.001). Symptoms related to dysphagia also were identified. Caregivers use their own techniques to manage dysphagia except two clients. No proper referral system was established in the current system. Current study can conclude the importance of using a detailed assessment for early identification of symptoms, level and the type of dysphagia. Proper protocol and referral pathway for speech and language therapists, caregiver/client training and counseling about dysphagia are essential. There is a high-risk prevalence of dysphagia among clients who are diagnosed with AD in Sri Lankan context.

Keywords: Alzheimer's disease, dementia, dysphagia management, speech and language therapist

*Corresponding author: eranthi46@gmail.com

Evaluation of *in vitro* sun screening activity of *Solanum violaceum* (Thiththa thibbatu) leaf extract

Kumari G.K.W.L.R.T., Dissanayake A.S.* and Hettihewa S.K.

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

In this study, the total phenolic content (TPC), total flavonoid content (TFC) and in vitro sun screening activity of 80% aqueous methanol extract of *Solanum violaceum* (Thiththa tibbatu) leaves were evaluated. TPC and TFC were determined by colorimetric methods using Folin-Ciocalteu reagent and aluminium chloride, respectively. Sun protection factor (SPF) was determined according to the Mansur equation using UV absorption data in the range of 290-320 nm (at 5 min interval) taken in methanol. The methanol extract of *S. violaceum* leaves was subjected to phytochemical screening for common phytochemicals and the results revealed the presence of phenolic compounds, flavonoids, saponins, carbohydrates and alkaloids. It was found to have a total phenolic and total flavonoid contents of 2781.168 ± 196.782 mg GAE/100 g DW, and 1151.048 ± 36.321 mg CAE/100 g DW, respectively. A concentration series of 1.0, 0.5, 0.2. 0.1 and 0.05 mg/ml solutions of *S. violaceum* extract was prepared in methanol along with the same concentration series of the reference Dermatone®. The SPF values were determined at all these concentrations and it was found that at 1.0 mg/ml concentration SPF value was 40 which is significantly higher than that of the reference Dermatone® (35) at the same concentration. It also has a SPF value of *ca* 12 at 0.2 mg/ml concentration which is close to the threshold value (15) of efficient sunscreen agents at that concentration. Finding of a significant sun screening activity in *S. violaceum* leave extract would open an avenue for the preparation of herbal sunscreens with little or no side effects.

*Corresponding author: arunasd@chem.ruh.ac.lk

An improved Brain-Computer Interfacing (BCI) system using intelligent agents

Pathirana S.[1]*, Asirvatham D.[2] and Johar G.[3]

[1]Department of Computer Science and Informatics, Uva Wellassa University, Badulla, Sri Lanka
[2]School of Computing & IT, Taylor's University, Subang Jaya, Malaysia
[3]IT and Innovation Center, Management & Science University, Shah Alam, Malaysia

Recognizing the brain's regional activity is highly beneficial for researchers who develop mind-controlled machines or computers. Electroencephalography (EEG) is a technology capable of detecting the electrical activity of the human brain, which is a result of the neural interactions incurred in performing brain functions. An accurate and efficient EEG data classification algorithm for real-time user intention detection, is the fundamental requirement of any Brain-Computer Interfacing (BCI) system. In this research, a Multi-Agent System (MAS) with Artificial Intelligence (AI), for improved accuracy and minimized computational cost, is employed in real-time EEG data classification. The accuracy of the MAS classifier was confirmed by comparing to different configurations of existing algorithms; Neural Networks, Decision Tree, Discriminant Analysis, Support Vector Machines (SVM) and K-NN using built-in tools available in MATLAB. The existing and MAS classification algorithms were evaluated using over 1,800 EEG data from ten (10) subjects and validated with V-fold cross-validation (MAS performed the best). A five (5) channel (AF3, AF4, T7, T8 & Pz) consumer-grade EEG data acquisition device "Emotiv's Insight" was utilized to acquire EEG data during training and real-time analysis, hence the implementation cost could be further reduced. The BCI system was tested not only for emulating the basic mouse or keyboard functions, but also for advanced computing tasks such as 3D modelling and programming, which is not accomplished by a typical (existing) BCI system. The overall accuracy of the improved BCI system was evaluated as 81.67%, the best reported in the class of BCIs equipped with consumer-grade EEG devices.

*Corresponding author: suneth@uwu.ac.lk

Common technique for detecting and correcting both non-word and real-word errors in Tamil sentences

Sakuntharaj R.[1*] and Mahesan S.[2]

[1]*Centre for Information and Communication Technology, Eastern University, Sri Lanka*
[2]*Department of Computer Science, Faculty of Science, University of Jaffna, Sri Lanka*

Erroneous words can be classified into two categories, namely *non-word errors* and *real-word errors*. These errors can occur in sentences when typing a document due to fast typing, switching of fingers on keys, input tools and method, or not knowing the right pronunciation, correct spelling or the meaning of the word. A common approach to correcting non-word and real-word errors in Tamil language is proposed in this paper. Erroneous words are detected by considering the appropriateness of the words in the context of the sentence. A *bigram probabilistic model* is constructed as it is simple and found to be good enough to determine the appropriateness of the valid word in the context of the sentence (than a trigram model). In case of lacking appropriateness, the word is marked as an erroneous word (non-word or real-word error) and *word-level trigram technique* is used to generate suggestions. In case of finding more than three suggestions, *word-level n-gram (unigram, bigram & trigram) language probabilistic model* is constructed to determine suggestions appropriate to the context. Test results show that the proposed erroneous word detection and correction system performs well. In our testing with 9170 sentences having 142 non-word errors & 119 real-word errors, bigram probabilistic model detects all of them successfully. The bigram probabilistic model detects non-word as well as real-word errors. For the 261 erroneous words, error correction module gives 583 suggestions, and 569 of 583 suggestions are found to be appropriate to the context. The suggestions produced by the system are checked by a Scholar in Tamil language and found to be 97.6% correct with F1-score of 0.99. This shows that the approach proved to be good for detecting and correcting real-word errors can be used for non-word errors as well.

Keywords: erroneous word, unigram, bigram, trigram and suggestion

*Corresponding author: sakuntharaj@esn.ac.lk

Real-time identification and classification of sensitive information on information transferring and sharing

Abeywardena K.Y.*, Kahandawaarachchi C., Mahanama V.M., Perera J.K.M.S., Bulathsinghe B.A.P.R. and Mel D.H.V.S.Y.

Department of Computer Systems Engineering, Faculty of Computing, Sri Lanka Institute of Information Technology, Malabe

Data Protection and Privacy are becoming a major concern all around the world. With the introduction of Data Protection Standards and Privacy Regulations, corporations are forced to comply with standards and regulations to continue their business. Privacy regulations such as the European Union General Data Protection Regulation, fine a considerable amount of money from corporates who violate requirements under the regulation. In order to manage the risk of non- compliance with such standards and regulations, it is a must for the corporates to implement controls to protect the company's data and the privacy of the company's customers. This paper discusses the application of data protection and privacy in the data-sharing phase of the data lifecycle using data identification, data classification, active monitoring and severity warnings. The developed system (PII-IC Engine) is aligned with current data protection and privacy regulations in the world; more specifically in lining with European Union General Data Protection Regulation and Payment Card Industry Data Protection Standard. PII-IC engine intends to identify and classify Personally Identifiable Information (PII) included in email communications and warn a logged-in user with the severity and sensitivity of the data being shared and log particular communication which includes PII and Payment card information. PII-IC Engine gives a 91.66% accuracy level for identifying GDPR and PCI DSS information in extracted text from image files, document files and email body content. Furthermore, proposed solution was able to identify sensitive email communications and take appropriate actions using various test scenarios. This will allow corporations to monitor and identify PII and Payment card data leakages, which happen due to the sharing of information through email communications via attachments, day-to-day organizational documents, and messages.

Keywords: privacy, data protection, Personal Identifiable Information (PII), General Data Protection Regulation (GDPR), Payment Card Industry Data Protection Standard (PCI DSS)

*Corresponding author: kavinga.y@sliit.lk

Inferring drug repositioning candidates using subnetwork identification

Hameed P.N.[1*], Verspoor K.[2] and Halgamuge S.[3]

[1]Department of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
[2]Department of Computing and Information Systems, University of Melbourne, Parkville, Australia
[3]Department of Mechanical Engineering, University of Melbourne, Parkville, Australia

Computational drug repositioning can reduce the cost, time and risks of drug development. This study demonstrates the benefits of identifying subnetworks from large-scaled drug similarity networks (DSNs) and the use of Anatomical Therapeutic Chemical (ATC) classification for inferring plausible drug repositioning candidates.

The subnetwork identification algorithms used in this study aim to infer drug repositioning candidates for a single disease at a time. The use of ATC classification enables analysis of multiple subnetworks to prioritize useful drug repositioning candidates. Here, the drugs related to the nervous system are chosen from ATC class-N to construct the drug similarity networks. Moreover, the hierarchy of the ATC classification is used to construct multiple meaningful DSNs. Since sparse graphs are known to be effective for subnetwork identification, we used a two-tiered clustering approach to construct sparse DSNs.

Our results suggest 'Physarum-inspired Subnetwork Identification Algorithm', a subnetwork identification algorithm inspired by the biological properties of the physarum organism, is effective in identifying subnetworks for DSNs that are 14.5% sparse. Further, an average Rand Index of 82.1% and an average Precision of 57.9% were observed in the identified subnetworks in relation to the drugs that are already in ATC class-N. These subnetworks can be analyzed further to investigate plausible drug repositioning candidates for nervous system diseases. Furthermore, using various subnetwork identification algorithms and various sparse graph generation methods would be beneficial in prioritizing plausible drug repositioning candidates.

Keywords: drug repositioning, ATC classification, subnetwork identification and sparse graphs

*Corresponding author: nusrath@dcs.ruh.ac.lk

Gender, race and religion prediction of Sri Lankan personal names using machine learning techniques

Chathuranga P.D.T.*, Loresnsuhewa S.A.S. and Kalyani M.A.L.

Department of Computer Science, University of Ruhuna, Matara, Sri Lanka

Prediction of identification details such as gender, race and religion of a person can help natural language processing related tasks to perform better. Also it can be used to speed up the existing digital application filling processes by providing suggestions. To the best of our knowledge, few researches were carried out on gender prediction and no research on race or religion prediction was carried out for Sri Lankan names. We performed gender, race and religion prediction based on Sri Lankan personal names, which were written using both Sinhala Unicode and English characters. Feature vectors were constructed as character n-grams and Multinomial Naïve Bayes & Support Vector Machine classification techniques were used for the prediction. Highest accuracies between 89% - 98% were obtained for all three predictions performed. Promising results demonstrated the possibility to use n-gram models with machine learning techniques to predict gender, race and religion of Sri Lankan names.

Keywords: natural language processing, machine learning, gender prediction and prediction of identification details

*Corresponding author: pdtcrc@gmail.com

Investigate factors causing deviations in construction project schedules and eliminate the reasons cause to projects delays in Sri Lanka

Perera H.S.*, Vijayaragunathan S. and Thalpage R.

Department of Civil Engineering, University College of Matara, University of Vocational Technology, Meddewatta, Matara, Sri Lanka

The ultimate goat of a construction firm is to complete a project with expected quality, within the estimated period and the budget. However, many projects in Sri Lankan construction industry experience extensive delays, thereby exceeding budgets in many instances. Schedule deviation is the often lead to costly disputes and claims between parties. Therefore, the aim of this research is to identify principle factors causing construction delays and ways and means of minimizing them. To achieve the objectives, a questionnaire survey was developed and distributed among professionals working in the construction filed. Principle factors that adversely cause delays were revealed as ineffective planning and scheduling of projects, mistakes and discrepancies in design documents and rework to correct errors that occur during construction. The study further identified principle parties that directly contribute for schedule deviation as the client, contractor and the consultant. It also revealed that proper project planning and scheduling, proper site management and supervision, collaborative working in construction, employment of well experienced professional for management and proper cash flow management as key strategies of minimizing such delays.

Keywords: construction industry, schedule deviation, principle factors and strategies

*Corresponding author: hirunikaperera3@gmail.com

Efficiency enhancement in dye-sensitized solar cells by co-sensitization with CdS quantum dots

Jaseetharan T.[1,2,3*], Dissanayake M.A.K.L.[1] and Senadeera G.K.R.[1,4]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[3]Department of Physical Sciences, South Eastern University of Sri Lanka
[4]Department of Physics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Quantum dots have received a considerable attention over the past decade due to their low fabrication cost and exceptional optoelectronic properties including tunable band gap with size by the quantum confinement effect and the ability of multiple exciton generation. Enormous efforts have been made to enhance the efficiencies of dye-sensitized solar cells (DSSCs) by modifications in both photoanodes and counter electrodes in these devices. Usually, the photoanode of a DSSC consists of a wide band gap semiconductor such as TiO_2 coated with a monolayer of dye molecules (usually Ruthenium based dyes, N719). However, these dye molecules generate electrons when they are excited by the solar energy in a particular wavelength range only. Therefore, in order to capture the whole energy spectrum in the sunlight, co-sensitization techniques can be employed in these DSSCs. In this work, the DSSC photoanode has been modified by co-sensitization with both, the N719 dye and CdS quantum dots. CdS quantum dots were deposited on the TiO_2 nanostructure by successive ionic layer adsorption and reaction (SILAR) method. Co-sensitized solar call shows an efficiency of 6.79% with a higher short-circuit current density of 15.55 mA cm^{-2} under the illumination of 100 mW cm^{-2} with AM 1.5 spectral filter. The corresponding solar cell sensitized only with N719 dye shows an efficiency of 6.10%. An enhancement of 12.11% in current density and 11.31% in efficiency have been achieved due to the co-sensitization of the DSSCs by the CdS quantum dots.

Keywords: co-sensitization, multiple exciton generation, quantum dot and quantum confinement effect

*Corresponding author: jaseetharan@seu.ac.lk

Design and construction of a low-cost AC conductivity meter to test solutions

Hansini K.L.T., Abeywickrama S.S. and Wickramasuriya N.T.*

Department of Physics, University of Ruhuna, Matara, Sri Lanka

Conductivity measurements in freshwater samples are crucial as drinking high conductive water could lead to health issues. A low-cost conductivity meter was constructed to measure low conductivities in the range that freshwater samples carry.

The device is constructed with two-pole cell made up of cylindrical Graphite electrodes. Alternating Current I, at optimal frequency 500 Hz was applied to the electrodes immersed in the solution and the voltage difference between the electrodes (V) was measured. The optimal frequency of the cell was determined by considering 50 - 2000 Hz frequency range of the supply voltage. Conductivity of the solution is directly proportional to the conductance, I/V. The cell constant (K_{cell}), which is the ratio of the conductivity to the conductance of the solution, depends only on the cell geometry. The cell was designed so that $K_{cell} = 0.247$ cm^{-1}. Standard KCl solutions in the range 5 - 2765 µS/cm at 25 ℃ were used to calibrate the device. Some standard NaCl solutions of 21, 64, 210, 617 and 1990 µS/cm were analyzed and found that those conductivities were in good agreement with their standard values up to 50 µS/cm. Conductivities of all solutions measured using a conductivity meter available in the market showed close agreement with standard values for low conductivity solutions, but showed a much higher difference of 320 µS/cm for the solution with conductivity 1990 µS/cm. 99.6 % accuracy with $\pm10^{-3}$ µS/cm tolerance can be expected from the constructed device for the range of conductivities, 5 - 2765 µS/cm.

Keywords: conductivity meter, construction, AC and freshwater

*Corresponding author: nadeeka@phy.ruh.ac.lk

Efficiency enhancement in dye sensitized solar cells with blended PVdF-HFP and PEO gel electrolytes

Kumari J.M.K.W.[1,2]*, Dissanayake M.A.K.L.[1], Senadeera G.K.R.[1,3] and Thotawatthage C.A.[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Physics, Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*

Electrolyte plays an important role in the photovoltaic performance of dye-sensitized solar cells (DSSCs) as it is responsible for efficient electron transfer from the counter electrode to the sensitizer via the redox species in the electrolyte. DSSCs containing liquid electrolytes have been reported with higher efficiencies. However, these DSSCs suffer several major draw backs due to the liquid nature of the electrolyte such as leakage, evaporation and thus, they need perfect sealing when long term stability is concerned. To overcome such problems, solid or quasi-solid (gel) state electrolytes have been utilized in these devices. Most of the DSSC gel electrolytes reported so far have been prepared using polyethylene oxide (PEO), polyacronitrile (PAN), poly (vinylidene fluoride-co-hexafluoropropylene) (PVdF-HFP) etc. Very few studies have been carried out on the utilization of blended polymer electrolytes in DSSCs. Therefore, in this study blended polymer electrolytes with PEO and PVdF-HFP were synthesized by varying the polymer composition ratios to obtain DSSCs with enhanced efficiency. DSSCs with the gel electrolytes were characterized by photocurrent-voltage and Electrochemical Impedance Spectroscopy (EIS). DSSCs with blended gel electrolyte having PVdF-HFP: PEO ratio of 80:20 wt% showed the highest efficiency of 6.46% under 100 mW cm^{-2} illumination and the highest ionic conductivity of 6.79 mS cm^{-1} at room temperature. The electrochemical impedance spectroscopy (EIS) measurements in DSSCs indicated a reduction of interfacial resistance between electrolyte and the Pt counter electrode and TiO$_2$ photo-anode because of the generation of a higher photo current due to usage of blended gel electrolytes.

Keywords: dye sensitized solar cells, blend polymers and electrolyte

*Corresponding author: kalpani.ku@nifs.ac.lk

Acetonitrile free liquid electrolyte for dye-sensitized solar cells

Umair K.[1*], Dissanayake M.A.K.L.[1,2] and Senadeera G.K.R.[1,3]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Physics, the Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*

Dye-sensitized solar cells (DSSCs) are the third generation, low cost photo electrochemical cells in solar energy harvesting applications. DSSCs usually employ a liquid electrolyte based on acetonitrile and the iodide/triiodide (I^-/ I_3^-) redox couple and have impressive energy conversion efficiencies. However, lack of durability due to liquid leakage, harmful solvent, electrode corrosion and photodecomposition of the dye in solvent medium due to usage of volatile liquids are some of the major drawbacks preventing large scale practical applications of liquid electrolyte based DSSCs. Therefore, in this study we have attempted to minimize above problems by replacing the toxic and volatile solvent, acetonitrile, by environmental friendly, high polarity and low volatile organic solvent propylene carbonate. Salt optimization was done by varying the weight of tetrapropylammonium iodide (TPAI) salt for new composition of electrolyte and DSSCs fabricated with above electrolytes were characterized with I-V measurements. Electrical Impedance Spectroscopic measurements were used to characterize the interfacial resistance of the different interface in the DSSC. The DSSC with the highest power conversion efficiency of 6.67% was achieved by using an electrolyte prepared with 0.17g of Tetrapropylammonium iodide (TPAI) salt dissolved in 0.4g of ethylene carbonate (EC) and 0.4g of propylene carbonate (PC), which gives almost the same efficiency as obtained with an electrolyte having acetonitrile as the solvent. This shows that acetonitrile can be replaced by propylene carbonate solvent without affecting the performance of DSSCs.

Keywords: CH_3CN, Organic solvent and non-volatile electrolyte

*Corresponding author: umair.ka@nifs.ac.lk

Meshfree based computationally efficient simulation of different shaped plant cells using the cell linked list algorithm

Hansani K.G.P.[1], Sumith B.[2] and Karunasena H.C.P.[2]*

1Department of Mathematics, University of Ruhuna, Wellamadama, Matara, Sri Lanka
2Department of Mechanical and Manufacturing Engineering, University of Ruhuna, Hapugala, Sri Lanka

This work presents an application of the Cell-Linked List Algorithm (CLLA) to improve the computational performance of Smoothed Particle Hydrodynamics (SPH) based plant cell with different cell shapes. CLLA is a computationally efficient neighbourhood treatment approach, compared to the popular All Pair Searching (APS) approach conventionally used for interaction calculations of SPH. Although CLLA has been existing in the numerical modelling field, this work newly introduces it to the sub-domain of different plant cell shape modelling. Accordingly, a series of simulations were conducted on SPH based state of the art plant cell modelling using three basic shapes; hexagon, round and square cellular domains to investigate the computational time saving of CLLA over APS. CLLA with maps was set up first as simple arrays in parallel C++ source code and it resulted in 17%, 23% and 30% reduction of the computational time compared to the use of APS in the same context. Next, CLLA was setup using the vector data structure in C++ by updating the above source code and it resulted in a much different computational time saving of 30%,16% and 17% compared to the original APS. The overall outcome of this research implies that the use of CLLA can yield significant computational savings than conventional APS based approaches.

Keywords: All Pair Search (Aps), Cell-Linked List Algorithm (Clla), computational time saving, plant cell shape modelling and Smoothed particle hydrodynamics (Sph)

*Corresponding author: chaminda@mme.ruh.ac.lk

Investigation of sound absorption properties of selected fruit plants

Amarasingha N.D.[1]*, Thilakarathna D.M.D.N.[1], Gunasekara T.M.A.D.[2], Bodhika J.A.P.[1], Dharmaratna W.G.D.[1], Jayatissa L.P.[2]

[1]Department of Physice, Faculty of Science, University of Ruhuna, Matara
[2]Department of Botany, Faculty of Science, University of Ruhuna, Matara

Four selected fruit plants, *Flacourtia inermis* (fɔdú), *Achras sapota* (සැපත්ඵලා), *Averrhoa carambola* (කාමරංකා), *Syzygium jambos* (ජාඹු), were studied for their sound absorption properties. Reverberation room method described under ASTM (American Society for Testing and Material) ISO 345 standard was followed throughout the experiment. B&K type 2250L handheld sound analyzer, Dodecahedron Omni Directional B&K speaker and an internal sound generator with a B&K Power amplifier were the major equipment used. Especially manufactured steel frames (1.2 m x 1.2 m) were used as plant holders. Measurements were repeated for three locations in the room and for each location ten measurements were taken. The time required to drop the sound level by 30dB, which is the reverberation time RT30, was measured in the room with and without the sample. The standard reverberation time RT60 was obtained by doubling the RT30 values. The sound absorption coefficient (SAC) for a unit volume of each plant type was calculated. The Sabine's formula was modified to calculate SAC. The study was performed in the sound frequency range 1.0–3.15 kHz.

The plant *Flacourtia inermis* shows significantly high SAC, increasing from 0.19 at 1.0 kHz up to 0.47 at 2.5 kHz and 0.39 at 3.15 kHz. The second-best type, *Syzygium jambos*, has SAC of 2.35 times lower at 2.5 kHz than that of *Flacourtia inermis*. Therefore, *Flacourtia inermis* plant could be used for noise screening.

Keywords: fruit plants, noise screens, reverberation room and sound absorption coefficient

*Corresponding author: andhanushka31@gmail.com

Compressibility characteristics of synthetic municipal solid waste at different phases of biodegradation

Pradeep W.T.R.A.[1]* and Priyankara N.H.[2]

[1]Division of Major Dams and Reservoir Operations, Mahaweli Authority of Sri Lanka, Maduruoya, Sri Lanka
[2]Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Galle, Sri Lanka

Results of a laboratory investigation conducted to determine compressibility characteristics of synthetic municipal solid waste (SMSW) at different phases of biodegradation is presented. SMSW samples were prepared based on the composition of municipal solid waste (MSW) generated in the Galle Municipal Council. Leachate collected from a landfill was added and recirculated to accelerate the degradation. Degradation phases were quantified based on the leachate characteristics and the each SMSW sample was tested at different phases of degradation for the compressibility characteristics of SMSW. Compression index (C_c) and secondary compression index (C_α) of SMSW from initial fresh stage to the degraded stage varied in the range 0.61 to 0.26 and 0.16 to 0.1, respectively. Degraded MSW shows lower settlement compared to fresh MSW. As the waste degraded, compression index (C_c) and secondary compression index (C_α) were decreased.

Keywords: synthetic municipal solid waste (SMSW), biodegradation, compressibility characteristics, compression index (C_c) and secondary compression index (C_α)

*Corresponding author: asankhapradeep@gmail.com

Unveiling an optimum method for modeling cluster S0 galaxies

Samararathna K.G.[1], Alahakoon A.G.P.D.[1], Prasadh K.V.S.[1]*, Barkhouse W.A.[2], De Silva W.M.K.[1], Perera H.A.D.S.D.[1] and Mahanama G.D.K.[1]

[1]Department of Physics, University of Ruhuna, Matara, Sri Lanka
[2]Department of Physics and Astrophysics, University of North Dakota, Grand Forks, ND 58202, USA

Galaxies and galaxy clusters provide hidden secrets of the formation and evolution of the universe. Lenticular or S0 type galaxies are defined as transitional galaxies between ellipticals and spirals. The formation of S0 galaxies is still an unsolved problem in extragalactic astronomy. Modeling galaxies can help to resolve this problem by extracting accurate parameters unique to S0 galaxies. In view of the aforementioned point, a sample of cluster S0 galaxies was selected from Dressler's 1980 galaxy cluster catalogue. Images of selected S0 galaxies were filtered from observed images taken at the Kitt Peak National Observatory (KPNO) using the 0.9 m telescope with 2048 x 2048 pixel T2K CCD. Each S0 galaxy was modeled using the two-dimensional image decomposition program called GALFIT and a newly developed python code. SAOImage DS9 application and Image Reduction Analysis Facility (IRAF) were used to visualize and crop cluster galaxies. From the available galaxy profiles in GALFIT, a Sérsic profile was used with different concentration parameters for modeling. The quality of the model was concluded by observing residual images. This was also confirmed using reduced χ^2 (χ^2_ν) values of models. Hence, generated models are applicable to study the nature of cluster S0 galaxies.

Keywords: S0 galaxies, galaxy modelling, GALFIT, reduced χ^2, sérsic profile

*Corresponding author: sandanuwan@phy.ruh.ac.lk

RISTCON
2020

Faculty of Science
University of Ruhuna

Survival analysis on end stage renal disease patients in Polonnaruwa district

Gunasekera H.S.P. and Satkunanathan N.*

Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

Chronic Kidney disease (CKD) is one of the major health issues in Sri Lanka, especially in the North Central Province. Further, End stage renal disease (ESRD) is the advanced stage of CKD. The purpose of this study is to identify the influential demographic and clinical characteristics factors on survival rate of ESRD patients. Time from disease diagnosis to the death of an ESRD patient was treated as a response variable while age, gender, area, diabetes and hypertension were treated as covariates. Data were collected from the records of the ESRD patients from the General Hospital, Polonnaruwa over the period from January 2016 to May 2018. Survival functions for categories of qualitative variables were estimated by using Kaplan Meier estimation method. Log rank test was applied to investigate whether there is a difference between the survival function among categories. In addition, Cox proportional hazard (Cox PH) model was applied to explore the association between survival rate of ESRD patients and covariates. It was observed that survival rate of ESRD patient is significantly related with age (HR = 2.321, p = 0.0203), diabetes (HR = 1.828, p = 0.0676), hypertension (HR = 2.289, p = 0.0221) and interaction between age and hypertension (HR = -1.847, p = 0.00648) at 10% significance level. Moreover, from Kaplan Meier estimator, it was observed that ESRD patients without diabetes have high survival rate than ESRD patients with diabetes. Furthermore, it can be concluded that for the patients whose age is less than 50, hypertension reduces the survival rate whereas for the patients from other age category, hypertension does not affect the survival rate.

Statistical analysis on factors affecting income-inequality in Sri Lankan labour force

Liyana Arachchi L.A.D.D.* and Varathan N.

Department of Mathematics and Statistics, Faculty of science, University of Jaffna, Jaffna, Sri Lanka

Studying inequality has become a crucial fact as inequality has increased considerably. The meaning of inequality refers to the difference in social status, wealth or opportunity between people or groups. There are many types of inequalities such as Income and Wealth, Cultural, Political, Racial and Gender inequality. Many studies reveal that Sri Lanka provides a huge downturn due to the inequalities exist among the people. It affects the living standards of the majority of the people living in Sri Lanka. Consequently, the development of the country is interrupted. In this study, the factors affecting on Income Inequality are analyzed. The data was collected from the Labour Force Survey 2016, conducted by the Department of Census and Statistics. Labour force in Sri Lanka is employed in different professions or occupations in various industries or sectors. The main root of Income of Sri Lankan employed population is the monthly salary. The possible factors affecting on the income inequality obtained through the literature are Age, Occupation type, Gender, English Literacy, Sinhala Literacy, Level of Education and the working sector of the employee. The multiple linear regression modeling approach has been used to analyze the impact of the factors on the monthly gross salary of Sri Lankan employees. Furthermore, the sequential methods, (forward selection method, backward selection method and stepwise regression) are used to identify the best model by means of the *p*-value, adjusted R-squared and Mean square error. Results of this research reveal that all the variables Age, Occupation type, Gender of the employee, English Literacy, Sinhala Literacy, Level of Education and the working sector of the employee significantly affect the monthly gross salary of an employee. Results obtained from this study are useful for prediction and future developments.

Keywords: multiple linear regression *, income inequality *, stepwise regression and salary

*Corresponding author: laddlarachchi930930@gmail.com

Classification of autoparatopisms of Latin cubes

Kumaranayake M.V.S.*

Department of Mathematics, University of Colombo, Colombo 03, Sri Lanka

An action on a Latin hypercube of dimension d and order n is called a paratopism if the action is an element of the wreath product $S_n \wr S_{d+1}$. A paratopism is said to be an autoparatopism if there exists a Latin hypercube, which is mapped to itself under the action of the paratopism. Given a Latin cube (when d = 3) and for each order n, ($n \in Z^+$), up to the conjugacy in $S_n \wr S_4$ a classification is presented. It is proved that given an autoparatopism $\sigma \in S_n \wr S_{d+1}$, every conjugate of σ is an autoparatpism. The most significant consequence for the process of classification is, if $\sigma_1 = (\alpha_1, \alpha_2, \alpha_3, \alpha_4; \delta_1) \in S_n \wr S_4$ and $\sigma_2 = (\beta_1, \beta_2, \beta_3, \beta_4; \delta_2) \in S_n \wr S_4$ then, σ_1 is conjugate to σ_2 in $S_n \wr S_4$ if and only if there is a length preserving bijection η from the cycles of δ_1 to the cycles of δ_2 such that if η maps a cycle $(a_1...a_k)$ to $(b_1...b_k)$ then $\alpha_{a_1}\alpha_{a_2}...\alpha_{a_k} \sim \beta_{b_1}\beta_{b_2}...\beta_{b_k}$. As a consequence, it can be concluded that every autoparatopism σ_1 is conjugate to another autoparatopism σ_2 which is of one of the forms $(\alpha_1, \alpha_2, \alpha_3, \alpha_4; \varepsilon)$, $(\varepsilon, \alpha_2, \alpha_3, \alpha_4; (1\ 2))$, $(\varepsilon, \varepsilon, \alpha_3, \alpha_4; (1\ 2\ 3))$, $(\varepsilon, \varepsilon, \varepsilon, \alpha_4; (1\ 2\ 3\ 4))$ or $(\varepsilon, \varepsilon, \alpha_3, \alpha_4; (1\ 3)(2\ 4))$.

Keywords: autoparatopism, conjugates, latin cube, latin square and paratopism

*Corresponding author: 2015s15193@stu.cmb.ac.lk

An improved kNN algorithm using K-means and fastText to predict sentiments expressed in Tamil texts

Thavareesan S.[1]* and Mahesan S.[2]

[1]Department of Mathematics, Eastern University, Sri Lanka
[2]Department of Computer Science, University of Jaffna, Sri Lanka

With the intention to develop a suitable approach to perform Sentiment Analysis on Tamil Texts using K-means clustering with k-Nearest Neighbour (k-NN) classifier, a corpus (UJ_Corpus_Opinions) consisting of 1518 Positive and 1173 Negative comments has been constructed. For training and testing 820 and 650 positive and 820 and 350 negative comments were considered, respectively.

Bag of Words (BoW) and fastText vectors were used to create feature vectors. These feature vectors were clustered using K-means clustering. The cluster centroids were used as classification keys for k-NN classifier. Two types of clustering techniques were utilised to develop two models: (i) using class-wise information, (ii) with no class-wise information. These two models were tested using K-Fold. All these four models were tested with the two types of feature vectors.

These models were tested using varying number of centroids (Kc:1..10), neighbours (Kn:1..Kc) and folds (Kf:1..10) to study their influence in the accuracy. The accuracy increases with the values of Kc, and the highest accuracy (74%) was obtained for Kn=1 and Kf=2. Accuracy, in general, was found to be more with fastText than with the BoW. It was noted that the model with fastText and class-wise clustering with K-Fold that obtained 74% accuracy has F1-Score of 0.74.

Keywords: sentiment analysis, Tamil, K-means, k-Nearest Neighbour and fastText

*Corresponding author: sajeethas@esn.ac.lk

Time series behavior of Indian visitors to Sri Lanka:
A post conflict perception

Gnanapragasam S.R.*

Department of Mathematics, The Open University of Sri Lanka, Nawala, Sri Lanka

Tourism has become a main income source for many developing countries. In 2017, totally 1,326 million of tourists travelled worldwide which was 7% increase when compared to 2016. As a result of this, USD 1,340 billion have been earned according to the receipts of international tourism which was 5% increase from 2016. Sri Lanka is one of the best countries to travel. Tourist arrivals to Sri Lanka were increasing after the internal conflict of more than 30 years, but a reduction was observed due to Easter Sunday attack in 2019, and again an increase is seen recently. India was the first among Sri Lanka's top five international tourist generating markets in recent past as the highest number of tourists visited among all counties was from India. Therefore, the aim of this study is forecasting Indian visitors to Sri Lanka. Thus, tourism industry and the policy makers can use this forecast to take necessary actions in future.

Monthly arrivals of Indians from January 2010 to August 2019 were considered for this study. Only in 2018, over 2.333 million of tourists had arrived in Sri Lanka which is about 10.3% increase with the arrivals in 2017. Nearly 425 thousand Indians visited Sri Lanka accounting to more than 18.2% of total arrivals. Until August in 2019, nearly 213,000 Indians arrived which is nearly 17% of total arrivals. The standard tests were applied to select seasonal $ARIMA(1,1,1)(1,1,1)_{12}$ as the best model and it showed nearly 93% forecasting accuracy. From this model, the estimated number of Indian visitors, in last 4 months in 2019, is nearly 170 thousand. Also in 2020, the expected Indian visitors are above 460 thousand and which is over 17% increase from 2019.

Keywords: *ARIMA*, forecast, Indian visitors, post conflict and tourism

*Corresponding author: srgna@ou.ac.lk

Sumudu decomposition method for solving the "Camassa Holm-nonlinear Schrodinger equation"

Thushanthani R.* and Mathanaranjan T.

Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

The standard dimensionless form of the Camassa Holm-nonlinear Schrodinger (CH-NLS) equation is studied here, which has the following form:

$$i\,m_t + u_{xx} + 2\varsigma m \left(|u|^2 - a^2 |u_x|^2 \right) = 0, \qquad m = u - a^2 u_{xx} \ , \quad \text{where} \quad u(x,t) \text{ is a}$$

complex field, $\sigma = \pm 1$ pertains to focusing or defocusing nonlinearity, a is a constant and subscripts denote partial derivatives. Approximate analytical solutions of the CH-NLS equation is derived by means of the Sumudu decomposition method (SDM), which is a combined form of the Sumudu transform and the Adomian decomposition method. The exact solution of the cubic nonlinear Schrodinger equation is given as a special case of our approximate analytical solution, which is compared graphically and numerically with the exact solution to verify the accuracy of the method. The results reveal that the proposed method is very efficient, simple and can be applied to other nonlinear problems.

Keywords: Camassa Holm-nonlinear Schrodinger equations, Adomian decomposition method, and Sumudu transformation

*Corresponding author: rajendranthushanthani@gmail.com

Application of ARIMA and ARIMAX models for forecasting paddy production in Anuradhapura district, Sri Lanka

Rathnayaka N.K., Laheetharan A.* and Satkunanathan N.

Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

Rice is one of the main staple foods for people in Sri Lanka and many other Asian countries. A great majority of village people in Anuradhapura district is occupied in paddy farming as their main livelihood. Therefore, forecasting of paddy production is an important aspect, to support socio-economic activities in the district. The total yield of seasonal (namely Maha and Yala) paddy production depends on various factors, harvest area, paddy type, rainfall, etc. The objective of this study is to construct better fitting forecasting models to predict paddy production based on autoregressive integrated moving average (ARIMA) model and Regression model with ARIMA errors (ARIMAX) using harvested area in Anuradhapura district as the input time series and paddy production as output time series. Model parameters are estimated by maximum likelihood method. Forecasting accuracy measures, Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE) are used to identify the best model based on the minimum measure of accuracy. Seasonal time series data of paddy production and harvested area were collected from Department of Census and Statistics, Sri Lanka for the period from Maha 1978 to Yala 2017. Based on minimum values of RMSE, MAE and MAPE criteria, ARIMA $(1, 0, 0)(0, 1, 1)_2$, ARIMA $(1, 0, 0)(0, 1, 2)_2$ and ARIMAX model with seasonal ARIMA$(0, 1, 1)(2, 0, 2)_2$ error series were selected as better fitting models among the ARIMA and ARIMAX models. Finally, the minimum measure of accuracy revealed that ARIMAX model is a better model than ARIMA models for the selected input variable.

Keywords: ARIMA, ARIMAX, paddy production, harvested area and forecasting

*Corresponding author: kalahee@yahoo.com

Forecasting the price of petroleum products in Sri Lanka

Ranawaka R.A.C.S.*

Faculty of Arts and Sciences, Sri Lanka Technological Campus, Meepe, Padukka

Crude oil, which has an important role in the global economy, can be recognized as one of the most important commodities for worldwide economic activity. This study leads to find the model to predict the future oil price in Sri Lanka with the time and factors effect on the oil price using regression analysis. This analysis is carried out with the monthly domestic prices of five petroleum products, Lanka petrol 95(LP95), Lanka petrol 92(LP92), Lanka auto diesel(LAD), Lanka super diesel(LSD), Lanka kerosene(LK) for 1990-2018. Trend analysis is conducted to find the models to predict future oil prices. According to that, either one or both linear and quadratic trend models are acceptable for all petroleum products. Regression analysis concluded that when the inflation rate(IR) is increased, the price of oil decreases for LP95 and also when market crude oil prices(MCOP) and dollar exchange rate(DER) are increased, the price of oil increases for all the petroleum products. Further, according to the best-fitted models, IR is not affected by the oil prices of LSD and LK. Furthermore, economic growth rate(EGR) is not affected by domestic oil prices in Sri Lanka.

Keywords: petroleum product prices, trend analysis models, multiple linear regression model

*Corresponding author: chathurir@sltc.ac.lk

Analysis of factors affecting on milk consumption among Matara district consumers: A case study

Dilshani S.D.M.* and Jayasekara L.A.L.W.

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka

Milk is one of the most essential foods to humans and it contains many nutrients such as protein, calcium, phosphorus, vitamin B2 and vitamin B12. Intake of a sufficient amount of milk products is recommended for healthy lifestyle of humans. The consumers' attitudes, demographic and socioeconomic factors are affect with their milk consumption behaviors in Sri Lanka. Therefore, the objective of this study was identify the appropriate factor structures of the consumer attitudes, demographic and socioeconomic factors which affect on milk consumption (either local milk or imported milk) among the Matara district. We conducted explorative factor analysis in order to discuss the correlation between the consumers' attitudes (observed variables) and latent variables (factors). To identify the factor solutions for the set of observed variables, the data from 421 were collected through a questionnaire based on the 16 variables. According to the Bartlett's Test it confirmed that the original variables are correlated and factor analysis useful with the data. Factor analysis was carried out the consumer attitudes, demographic and socioeconomic factors as independent variables which can be categorized into Socio Economic Group, Cost and credibility, Sensitivity, Availability and Marketing using principal component exaction method and varimax rotating method. The KMO statistic indicated that 0.753 (> 0.6) which confirmed that the validity of the factor analysis.

Keywords: milk consumption, factor analysis, KMO test and Bartlett's test of sphericity

*Corresponding author: madushadilshani@gmail.com

Identifying the factors affecting real LKR/USD exchange rate

Perera S.S.N.P. and Lansakara L.H.M.R.B.*

Department of Mathematics, University of Colombo, Colombo 03, Sri Lanka

This study has investigated the macroeconomic factors affecting real LKR/USD exchange rate by using monthly data from January 2013 to July 2019. The explanatory variables of this study are net foreign assets, domestic Treasury Bonds yields and Treasury Bonds yields in United States (US). Vector Error Correction Model (VECM) is used to estimate the model. Long run equation without surprisingly indicates that the yield rates in US has the most significant influence over real LKR/USD exchange rate determination negatively. Recently, US have increased its interest rates (latter part of 2018) and that event may have significantly contributed to the recent nominal LKR/USD exchange rate depreciation. Second most significant explanatory variable is the interest rates in Sri Lanka and it influences negatively to the real LKR/USD exchange rate determination. Hence, we can draw a finding that foreign investment is a significant determination of the real LKR/USD exchange rate as relative interest rates of the both countries determine the investment flows to the Sri Lankan economy. Net foreign assets negatively relate with the real LKR/USD exchange rate and it highlights the fact that accumulation of foreign assets strengthens the domestic currency. Previous month's deviation from long run equilibrium is corrected in the current month as an adjustment speed of 91 percent. Significant variable for the real LKR/USD exchange rate determination in the short run is the net foreign asset.

Keywords: real exchange rate, vector auto regression and vector error correction model

*Corresponding author: ihmbandara@hotmail.com

G- Frames in the quaternionic setting

Khokulan M.* and Sangarthas M.

Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

Quaternions are an extension of complex numbers with one real and three imaginary parts. Quaternionic Hilbert space is a vector space under multiplication by quaternionic scalars, from the non-commutativity, the quaternionic Hilbert spaces are defined in two ways: left/right quaternionic Hilbert spaces. Frame is a spanning set of vectors, which are generally over complete (redundant) in a quaternionic Hilbert space. G- frames are natural generalization of frames and provide more choices on analyzing functions from frame expansion coefficients. In this research, the construction of G-frame is reported and relation between G-frame and canonical dual G-frame is established. Let $U_{\mathbb{H}}^L$ and $V_{\mathbb{H}}^L$ be left quaternionic Hilbert spaces and $\{\mathcal{V}_k : k \in \mathbb{I}\} \subseteq V_{\mathbb{H}}^L$ is a sequence of quaternionic Hilbert spaces. Let $\mathfrak{B}(U_{\mathbb{H}}^L, \mathcal{V}_k)$ be the collection of all bounded linear operators from $U_{\mathbb{H}}^L$ into $\mathcal{V}_k$. A family $\{\Gamma_k \in \mathfrak{B}(U_{\mathbb{H}}^L, \mathcal{V}_k) : k \in \mathbb{I}\}$ is called a generalized frame or simply G-frame for $U_{\mathbb{H}}^L$ with respect to $\{\mathcal{V}_k : k \in \mathbb{I}\}$ if there exist constants $0 < C \leq D < \propto$ such that $C\|\phi\|^2 \leq \sum_{k \in \mathbb{I}}\|\Gamma_k\phi\|^2 \leq D\|\phi\|^2$, for all $\phi \in U_{\mathbb{H}}^L$, where C and D are G-frame bounds. G-frame operator F_g can be defined as $F_g\phi = \sum_{k \in \mathbb{I}} \Gamma_k^{\dagger} \Gamma_k\phi$, for all $\phi \in U_{\mathbb{H}}^L$, where $\Gamma_k^{\dagger}$ is the adjoint operator of Γ_k. Frame operator F_g is self adjoint, bounded and invertible. If $\{\Gamma_k : k \in \mathbb{I}\}$ be a G-frame for $U_{\mathbb{H}}^L$ with respect to $\{\mathcal{V}_k : k \in \mathbb{I}\}$ and $\widetilde{\Gamma_k} = \Gamma_k F_g^{-1}$, then $\{\widetilde{\Gamma_k} : k \in \mathbb{I}\}$ is a G-frame for $U_{\mathbb{H}}^L$ with frame bounds $\frac{1}{D}$ and $\frac{1}{C}$. We call it the canonical dual G-frame of $\{\Gamma_k : k \in \mathbb{I}\}$. Finally, we conclude that $\{\Gamma_k : k \in \mathbb{I}\}$ and $\{\widetilde{\Gamma_k} : k \in \mathbb{I}\}$ are dual G-frames with respect to each other.

*Corresponding author: mkhokulan@gmail.com

The fama and french three factor model: Evidence from Colombo stock exchange

Nayanarasi K.H.D.* and Perera S.S.N.

Research & Development Centre for Mathematical Modeling, Department of Mathematics, University of Colombo, Colombo 03, Sri Lanka

This study tested Fama and French Three Factor Model on the banking, finance and insurance sector of the Colombo Stock Exchange using monthly stock data of 34 listed companies for a period of six years, ranging from October 2012 to December 2018. This study showed a significant and zero intercept which would imply the factors outside the market factor, size, and value factor are not explaining the mean return of the portfolios. The study further found that the market factor, in all the portfolios, plays a key role in explaining variation in stock returns. This study concluded that Fama and French Three Factors model has the ability to explain the cross-sectional variations of average returns on Sri Lankan stock market and it has a significant fit when compared to the Capital Assets Price Model.

Keywords: fama and french three-factor model, capm model, colombo stock exchange and stock returns

*Corresponding author: dnnayanarasid@gmail.com

Markov chain model application on stock market price of Sri Lankan private banks

Anuthrika T. and Jeevana D.*

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka

Analyzing stock prices is essential from the investor's point of view to make effective decisions regarding their investment. Therefore, this paper studies a Markov chain application on stock market price. This paper provides a Markov chain analysis on stock prices of three of the top banks; Hatton National Bank (HNB), Commercial Bank (CB) and National Development Bank (NDB) in Sri Lanka.The closing prices of each trading day of each of the above three banks were obtained during the period of Jan 2017 to June 2018. Two approaches have been followed to define the states of the system. For each bank, the states were considered as gain or loss for model 1 and high increment, moderate increment, small increment, small loss, moderate loss and high loss formodel 2. The Transition probabilities, steady state probabilities and mean recurrent time were obtained for these two models and compared among the banks. Based on the model 1, it is revealed that the chance of getting gain is comparatively high for all the banks. Further, it was noted in the steady state that there is 65% chance of getting gain and 35% chance of getting loss for HNB shareholders. According to model 2, the chance of getting small increment is high for each of the three banks. Also, noted that, for HNB shareholders there is 45% chance of getting small increment in near future.

Building an identity verification system with high security using elliptic curve digital signature algorithm

De Silva P.D.D.C. and Yapage N.*

Department of Mathematics, University of Ruhuna, Wellamadama, Matara, Sri Lanka

We construct a web based Identity Verification System called AuthC which is built upon ECDSA with SHA256 (Elliptic Curve Digital Signature Algorithm with Secure Hashing Algorithm 256 bit versions), which uses ECDSA as a method of verifying the source of the requests. The main reason to introduce AuthC is to fulfill the trust gap, when one faces the identity verification problems. AuthC may be very useful when authentication is the main requirement.

AuthC is a web based application with high security which fulfills the trust gap between two strangers. Basically, AuthC ensures the identity of an identification card holder by providing basic information such as name, address, birth date, general appearance, and any other identification or individual information of the holder, which are provided by authorized parties. These can be related to educational status, crime history, civil status, etc. AuthC can help society by verifying identification card of an individual easily and accurately, and also by updating and linking all personal information of the holder in real time. Moreover, the proposed cryptosystem has the potential of implementing as a commercial product with high fidelity.

Technically AuthC is developed using RESTful service, which is built on the REST (REpresentational State Transfer) architecture, SpringBoot (https://spring.io/projects/spring-boot), VueJS (https://vuejs.org), and Bootstrap (https://getbootstrap.com) Frameworks. RESTful service is a web service, which is used to communicate between applications, services or any other softwares.

Keywords: cryptography, elliptic curve cryptography, elliptic curve digital signature algorithm, authentication and identity verification

*Corresponding author: nihal@maths.ruh.ac.lk

Analysis of the performance of players of cricket world cup 2019 by principal component analysis

Wedage L.T. and Jayasekara L.A.L.W.*

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka

ICC Cricket World Cup is the international championship of One Day International cricket organized by the International Cricket Council (ICC). Top teams in the ICC world cricket rankings are automatically qualifying to the cricket world cup. The main objective of this study is to introduce a new method to rank the players by their recent performance and that would enable to select the most skilled players to the Sri Lankan cricket team. Sub-objective of the study is to pose the rankings of the Sri Lankan players who perform well in the ICC Cricket World Cup 2019. Principal Component Analysis is used to rank the batsmen and bowlers by their performance in the ICC Cricket World Cup 2019. The first principal component is seen to explain 84% and 73% of the variation in a linear combination of some commonly used measures of the batting and bowling prowess respectively. Four batsmen and two bowlers in Sri Lankan team secure ranks out of 50 batsmen and 47 bowlers who performed well in the ICC Cricket World Cup 2019 respectively.

Keywords: cricket, principal component analysis and rank

*Corresponding author: leslie@maths.ruh.ac.lk

Influence of 5A's on domestic tourists' satisfaction in Hikkaduwa, Sri Lanka

Samaraweera K.G.[1]* and Upekshani T.G.Y.[2]

[1]*Department of Economics, University of Colombo, Sri Lanka*
[2]*Department of Economics, University of Sri Jayewardenepura, Sri Lanka*

Tourism is one of the emerging sectors in the world, which contributes about 10% to global gross domestic product. As an island Sri Lanka has great opportunities to promote tourism. Hikkaduwa is an eye-catching area, which mesmerize both international and domestic tourists. Sri Lankan tourism industry is in a backward position in promoting domestic tourism. Under this backdrop this study seeks to investigate the factors, which maximize domestic tourists' satisfaction in Hikkaduwa, Sri Lanka. The general objective of this study is to identify the Western province domestic tourists' perception towards the satisfaction gained by 5A's in Hikkaduwa. Furthermore, the study attempts to identify the factors that influence the domestic tourists' satisfaction in Hikkaduwa. The study adopted the convenience sampling technique to generate a sample of 485. The operational methodology for this study is a factor analysis and structural equation model. First stage is the exploratory factor analysis to identify major factors that influence domestic tourists' satisfaction in Hikkaduwa. Second stage is the confirmatory factor analysis to confirm the identified major factors from the exploratory factor analysis. Finally, the structural equation model to identify the relationships between the identified factors in the model. The study found that Accommodation, Amenities, Attractions, Accessibility and Activities influence the domestic tourists' satisfaction in Hikkaduwa. Moreover, the study revealed that Accommodation, Amenities, Attractions, Accessibility and Activities have a significantly positive impact on domestic tourists' satisfaction in Hikkaduwa. However, the activities impact 95% on domestic tourists' satisfaction and it is the most crucial factor.

Keywords: domestic tourism, tourists' satisfaction, 5a's and factor analysis

*Corresponding author: kanchanageeth@gmail.com

Prime labeling of a star graph

Thennakoon T.R.D.S.M.* and Perera A.A.I.

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka

A graph $G = (V(G), E(G))$ with $|V(G)|$ vertices is said to have prime labeling if there exist a bijective map $f : V(G) \rightarrow \{1, 2, 3, \dots, |V(G)|\}$ such that for each edge $e = uv$ in $E(G)$, $f(u)$ and $f(v)$ are relatively prime. A graph G which admits prime labeling is called a prime graph. A complete bipartite graph is a simple bipartite graph in which each vertex in one partite set is adjacent to all the vertices in the other partite set. A $K_{p,q}$ graph is a complete bipartite graph which has p vertices in one partite set and q vertices in other partite set, where $p, q \geq 1$. If $p = 1$, then $K_{1,q}$ graph is called a star graph. The present work focuses on prime labeling on simple finite undirected graphs related to star graph. We proved that the graphs obtained by replacing every edge of star graph $K_{1,n}$ by $K_{2,5}$ is a prime graph, where $n \geq 1$.

Keywords: prime labeling and prime graphs

*Corresponding author: dasunthennakoon94pdn@gmail.com

Some results related with fuzzy metric space and strong fuzzy metric   space

Kajan N.[1]*, Kannan K.[1] and Sritharan T.[2]

[1]*Department of Mathematics and Statistics, University of Jaffna, Sri Lanka*
[2]*School of Computing, University of Colombo, Sri Lanka*

The problem of constructing a satisfactory theory of fuzzy metric spaces has been investigated by several researchers from different point of view. The concept of fuzzy sets was introduced by L.A.Zadeh. Following fuzzy metric space and fuzzy b −metric space modified by I.Kramosil, J.Mickalek-George and Veeramani using continuous triangular norm. A binary operation $*:$ $[0,1] \times [0,1] \longrightarrow [0,1]$ is a continuous triangular norm (t −norm), if $*$ is associative, commutative, continuity, monotonicity and 1 acts as identity element. Some typical examples of t −norm are product t −norm, minimum t −norm, lukasiewitz t − norm and hamacher t −norm. In our work we used minimum triangular t −norm and Banach fixed point theorem to prove fixed point theorem in fuzzy metric space and used control function to prove fixed point theorem in strong fuzzy metric space. Letting $(X, M, *)$ be a complete fuzzy metric space and $T : X \longrightarrow X$ is a continuous function   satisfying   the condition $M (Tu, Tv, t) \geq \min\{M (u, Tu, t), M(v, Tv, t), M(u, v, t)\}$ and $\lim_{t \to \infty} M (u, v, t) = 1$, where $u, v \in X$, $u \neq v$ and M is a Fuzzy set. We proved T has a fixed point in X and also letting $(X, M, *)$ be a complete strong fuzzy metric space with continuous triangular norm $*$ and T is self-mapping in X. If there exists control function φ and $\lambda_i = \lambda_i (t)$, $i = 1,2,3,4,5$, $\lambda_i \geq 0$ and $\lambda_1 + \lambda_2 + \lambda_3 + 2\lambda_4 + \lambda_5 < 1$ such that
$\varphi \left(M(Tu, Tv, t) \right)$
$\leq \lambda_1 \varphi \left(M(u, Tu, t) \right) + \lambda_2 \varphi \left(M(v, Tv, t) \right) + \lambda_3 \varphi \left(M(Tu, v, t) \right)$
$+ \lambda_4 \varphi \left(M(u, Tv, t) \right)$
$+ \lambda_5 \varphi \left(M(u, v, t) \right)$
Then T has a unique fixed point in X.

3-factors of 3-factorization of $K_{3,3,3,\cdots,3}$ with n-partite sets for all even integers $n \geq 2$

Weerarathna M.D.M.C.P.*, Dissanayake D.M.T.B and Perera A.A.I.

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka

Graph Theory is an important area in mathematics with many applications, one of the important areas in graph theory is factorization of graphs. It is one of the most flourishing research area in Graph Theory. A factor of a graph G is a spanning sub-graph of G which is not totally disconnected and factorization of a graph G is a set of spanning sub-graphs of G that are pairwise edge-disjoint and whose union is G. Most of the research work on factorization of graphs is on complete bipartite graphs. Our research work is for complete multipartite graph of the form $K_{3,3,3,\cdots,3}$. In our previous work, 2-factors of 2-factorization of the complete multipartite graphs $K_{2,2,2,\cdots,2}$ and $K_{2^r,2^r,2^r,\cdots,2^r}$ have been constructed by using degree factors. In this work, by considering degree factorization, a theorem has been proved using Mathematical Induction to obtain 3-factors of 3-factorization, for different values of $n \in \mathbb{Z}^+$, of the complete multipartite graphs $K_{3,3,3,\cdots,3}$ with n partite sets. It has been shown that a complete multipartite graph with $2n$ partite sets of the form $K_{3,3,3,\cdots,3}$ has $\dfrac{^{2n}C_2}{n} = 2n-1$, 3-factors for a 3-factorization for $2n$ partite sets. Furthermore, it is found that the tournament scheduling technique can be used to obtain the number of 3-factors of 3-factorization.

Keywords: complete multipartite graph, factorization and tournament scheduling technique

*Corresponding author: chinthakaweerarathna@gmail.com

An alternative method to solve a system of one-variable linear congruences with prime moduli

Wijerathna P.A.S.D.* and Ranasinghe P.G.R.S.

Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

We consider a system of linear congruences of a single variable with specific conditions and construct a new faster method to solve that system without using the Chinese remainder theorem . The concerned system of congruences is $a_i x \equiv b_i \, mod(m_i)$, for $0 < a_i, b_i < m_i$ for all $i = 1, 2, 3, \ldots, n$ with all m_i values are prime. This system can be reduced to a single linear congruence of the same variable and it has a unique solution. The single congruence is

$$(a_1 M_1 + a_2 M_2 + \cdots + a_n M_n)x \equiv (b_1 M_1 + b_2 M_2 + \cdots + b_n M_n) \, (\bmod \ M \ )$$

where $M = m_1 \times m_2 \times \ldots \times m_n$ and $M_i = \dfrac{M}{m_i}$ for all $i = 1, 2, 3, \ldots, n$.

The unique solution of the single congruence is the solution of the above system.

Keywords: Chinese remainder theorem, linear congruence and prime modulo

*Corresponding author: shshikadilshan1234@gmail.com

Faculty of Science
University of Ruhuna

RISTCON
2020

Poly (methyl methacrylate) based gel-polymer electrolytes for sodium-ion secondary batteries - A comparative study with different ionic salts

Jayamaha J.H.T.B.[1], Menisha G.[1,2], Keppetiyawa K.G.H.S.[1], Senavirathna S.L.N.[1], Vignarooban K.[1]*, Sashikesh G.[3], Veluathamurthy K.[3], Wijayasinghe H.W.M.A.C.[4] and Dissanayake M.A.K.L.[4]

[1]*Department of Physics, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka*
[2]*University College of Jaffna, 29 Brown Road, Jaffna, Sri Lanka*
[3]*Department of Chemistry, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka*
[4]*National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*

Natural abundancy of sodium in the Earth's crust and also in the oceans has popularized sodium-ion batteries (SIBs) as a low-cost alternative to expensive lithium-ion batteries. A few types of SIBs are already in the commercial markets for stationary energy storage applications, but they employ liquid electrolytes. Due to the larger size of Na^+ ions compared to that of Li^+ ions, the ionic conductivity of sodium-ion conducting solid electrolytes would be insufficient for practical applications. A common strategy adopted has been to develop gel-polymer electrolytes (GPEs). In this work, we developed Poly (methyl methacrylate) (PMMA) based GPEs with four different ionic salts ($NaBF_4$, $NaPF_6$, $NaCF_3SO_3$ and $NaClO_4$) dissolved in EC:PC (ethylene carbonate and propylene carbonate, 1:1 wt%) mixture. Among the four different GPE samples investigated by Electrochemical Impedance Spectroscopy (EIS) and FTIR techniques, the best ambient temperature ionic conductivity of 3.7 mS cm^{-1} was obtained for PMMA:NaClO$_4$:EC:PC (18:6:38:38 wt%) GPE. Variation of ionic conductivity with inverse temperature showed Arrhenius behavior with almost constant activation energies of about 0.17 eV for all the samples. Broadening of the FTIR vibrational bands at 670-1000 and 1400-1600 cm^{-1} is ascribed to the lowering of crystallinity resulting from the formation of PMMA/Na$^+$ complex through Na$^+$ ion solvation by the polymer host. The best conducting GPE (18PMMA:6NaClO$_4$:38EC:38PC wt%) synthesized with NaClO$_4$ ionic salt is highly suitable for practical applications in SIBs as it has sufficient ambient temperature ionic conductivity in the order of mS cm^{-1}.

Keywords: sodium-ion batteries, gel-polymer electrolytes, electrochemical impedance spectroscopy, ionic conductivity and vibrational modes

*Corresponding author: kvignarooban@gmail.com

Factors affecting for the consumer demand of selected low country vegetable in Sri Lanka

Karunarathna W.M.R.N.* and Premarathne N.M.K.C.

*Department of Agricultural Systems, Faculty of Agriculture, Rajarata University
of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka*

Vegetable consumption has recognized as essentials for healthy life. However, Sri Lankan's daily vegetable intake is less than the recommended quantity by World Health Organization. Vegetable consumption has a diverse pattern in society. Thus, the study aims to investigate the factors affecting for consumer demand of okra, bitter gourd, long bean, snake gourd, ridge gourd, pumping, tomato, wing bean, drumsticks, kekiri, eggplant and thibbatu. Monthly vegetable consumption data used for dependent variable while price, income, *age*, level of education and consumers' living sector data used for independent variables (Household income and expenditure survey 2016). Sample size was 21,756 housing units representing urban, rural and estate sectors. Data were analyzed using the double log demand function. The own price was negatively significant and income was positively significant for all selected vegetables at $P \leq 0.05$. Education was negatively significant ($P \leq 0.05$) for all except wing bean, eggplant and thibbatu. The educated people have considered the quality and diversity of the diet rather the quantity. However, urban households have consumed less amount of okra, long bean and pumpkin compared to rural and estate households. But tomato consumption is high in the urban sector comparatively. Family size was not significant for any selected vegetable. Thus, it can be concluded consumer demand for low country vegetable depends on own price, income, level of the education of household head and living sector of consumers. The study recommended that effort should be made to increase low country vegetable production to control price escalation.

Keywords: double log demand function, price and income

*Corresponding author: ridminkarunarathna@gmail.com

Production of *Aloe vera* incorporated pasteurized herbal milk drink and investigation of its organoleptic properties and shelf life

Jayaweera B.P.A.[1], Nayana P.[2], Beddegamage N.M.[2] and Vithushana T.[1]*

[1]*Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Gonawila, Sri Lanka*
[2]*Fonterra Brands Lanka (Pvt) Ltd, Biyagama, Sri Lanka*

Dairy industries have high demand for the products that meet consumer's demand for a healthy lifestyle. Currently the interest and use of *Aloe vera* pulp as a functional ingredient has increased tremendously. In this backdrop, present study was carried out to develop a novel herbal pasteurized milk drink through the investigation of its organoleptic properties and shelf life for commercialization to satisfy the needs of health-conscious consumers. The product was developed by incorporating 5% of *A. vera* pulp, different levels of sugar (3 – 9%), pH (3.00 – 4.50) levels and flavors according to the consumer preferences. The organoleptic properties of final product such as appearance, flavor, aroma, texture/ mouthfeel, overall-taste, overall-acceptability and consumer acceptance were observed once in 7 days. Microbial parameters such as aerobic plate count, coliform count and physicochemical parameters such as pH, total solids, total soluble solids and discoloration were examined every 5 days interval to evaluate the safety and keeping quality of the product. The data obtained were analyzed statistically. *A. vera* incorporated pasteurized herbal milk drink was accepted by the sensory panelists. All sensorial attributes tested in the formulated product during the storage period scored above 7 in 9-point hedonic scale which revealed that the product was towards the "extremely-like" category. There was no significant difference in all analyzed parameters during the storage period of 14 days and matched with the Sri Lankan standard for milk added pasteurized drink. So, the study led to the conclusion that the *A. vera* incorporated herbal milk drink possessed good overall acceptability and physiochemical quality with the shelf life of 14 days.

Keywords: *Aloe vera*, consumer, herbal, milk and pasteurized

*Corresponding author: vithushanathangarajah@gmail.com

Temporal variation of flowering and fruiting of *Calotropis gigantea* in Southern province, Sri Lanka

Wijeweera W.P.S.N.* and De Silva M.P.K.S.K.

Department of Zoology, University of Ruhuna, Matara, Sri Lanka

Calotropis gigantea is a native plant in several Asian countries including Sri Lanka. It is a drought resistant, salt tolerant plant with aurvedic medicinal values. However, the plant is considered as an invasive species in countries like Australia, Brazil, Mexico and USA. Knowledge on the flowering and fruiting associated with plant reproduction is important in studying distribution of the plant, conservation purposes in native countries, as well as to adapt measures to control invasiveness in introduced countries. Present study aimed to find out temporal variation of flowering and fruiting of *C. gigantea* in Southern Province of Sri Lanka. Monthly field visits were conducted in 11 selected sites representing three districts; Matara, Galle and Hambantota of Southern Province from August 2015- August 2016. Presence/ absence of flowering, fruiting and number of fruits in each selected plant in every site were recorded. Floral production in plant studied was observed throughout the year. Fruit production varied according to individuality indicating fruits per tree as 0 to177. Fruiting varied during the year and the highest fruiting (81.8%) was in May while the lowest fruiting (0 %) observed in November. Correlations indicated that rainfall (p = 0.025), relative humidity (maximum) (p = 0.026) and temperature (maximum) (p = 0.025) facilitates the *Calotropis* fruit production. In Galle district, temperature (minimum) also supports (p=0.048) the *Calotropis* fruit production. Present study provides information on temporal variation of flowering and fruiting of *Calotropis* in selected regions of Sri Lanka, which has not been recorded before.

Keywords: calotropis flowering, calotropis fruiting and invasive calotropis

*Corresponding author: surendi87nisha@gmail.com

Study on outbreaks of brown planthopper (*Nilaparvata lugens*) in rice cultivation; A farmer survey

Sarathchandra S.R.*, Bandara R.M.U.S., Senarath S.A.T.P., Bandaranayake
M.A.B.R.P., Madhuvanthi A.G.N.H., Perera P.G.K., Bandara W.M.H.R.S.S.,
Dissanayake D.M.O.K.B. and Rajapaksha R.M.C.Y.

Rice Research and Development Institute, Ibbagamuwa, Sri Lanka

Brown Planthopper (BPH), *Nilaparvata lugens* causes adverse effect to rice production in Sri Lanka. Over the last three decades, the area affected and damaged by BPH fluctuated respectively from 0.01% to 5% and from 0.01% to 0.1% of the annual cultivated extent. Therefore, it is essential to take precautions to keep the pest incidence under threshold levels and prevent spreading through sustainable management of BPH dispersion in paddy production systems in Sri Lanka. This study was conducted to understand the farmers' pest management practices and evaluates its effect on the BPH damage management. The selection of the study areas was based on the irrigation regime. Therefore, Kurunegala, Rathnapura and Mahaweli system B, C have been selected representing the rain-fed, minor irrigation and major irrigation system categories respectively. A pre-tested questionnaire survey was conducted in Maha season of 2018/19 using interview method to collect data140 farmers from four selected areas by using simple random sampling methods. This survey revealed that, BPH was the dominant pest as in these three districts and even the majority of experienced farmers in these areas, followed improper pest management practices such as improper land preparation practices (10%- Kurunegala 12% Ratnapura, 20% - Mahaweli B, 25% Mahaweli C), seed rate utilization (>40kg/Ac 23% Kurunegala, 10% Ratanapura, 38% Mahaweli B, 40% Mahaweli C), late identification (22% Kurunegala,18% Ratnapura, 32% Mahaweli B, 40% Mahaweli C and chemical application. Therefore, in order to minimize the risk of BPH, conducting farmer awareness and demonstration programs, selecting proper insecticides, proper spray volume and applying them at a correct time and following a proper method of application can be made into practice.

Keywords: management practices, *Nilaparvata lugens*, outbreaks and rice

*Corresponding author: entomologyrrdi@gmail.com

Effect of BAP and coconut water on growth and multiplication of immature male flowers of kolikuttu banana (AAB) variety 'Agra'

Shirani D.A.[1]*, Wijithasiri P.M.D.I.[2], Amarasekara D.A.B.N.[2] and Abeysinghe P.D.[3]

[1]Grain Legume and Oil crops Research and Development Centre, Angunakolapelessa
[2]Department of Crop Science, Faculty of Agriculture, University of Ruhuna
[3]Department of Botany, University of Ruhuna, Matara, Sri Lanka

Shoot tip culture is the most common technique in *in-vitro* clonal propagation of banana. Male buds, immature hands and male flowers can also be used as explants for micropropagation. However, the plants produced using these types of explants may have variations, which can be used in banana improvement. Therefore, the present study was undertaken to develop a plant regeneration protocol for kolikuttu variety 'Agra' through male bud culture technique. In the present experiment, 2 different sizes (<10 mm and 10-20 mm) of male flowers of 'Agra' were cultured on 4 MS media combinations (1: MS+5 mg/l BAP+1mg/l NAA+1mg/l Ascorbic acid+150 mg/l CW+30g /l sucrose, 2: MS+8 mg/l BAP+1mg/l NAA+1mg/l Ascorbic acid+150 mg/l CW+30 g/l sucrose, 3: MS+5 mg/l BAP+1mg/l NAA+1mg/l Ascorbic acid+30 g/l sucrose, 4: MS+8 mg/l BAP+1mg/l NAA+1mg/l Ascorbic acid+30 g/l sucrose) and subcultured once in 4-6 weeks. Experiment was laid as CRD 2 factor factorial with 25 replicates. ANOVA and mean separation were performed for data analysis using SAS 9.1.3 software. Results showed that <10 mm hand size performed better than the larger explants for the growth of hands and formation of shoot like structures. The growth of explants cultured on medium supplemented with 8 mg/l BAP without coconut water was found to be better than the other media. The treatment of combination of <10 mm hand size and 8 mg/l BAP without coconut water formed significantly high numbers (1.52, 6.48 and 6.18) of white color bodies per explant in first, second and third subculture cycles respectively. However, medium supplemented with 5 mg/l BAP produced significantly high number of shoots like structures in third subculture. Although coconut water contains growth promoting substances, medium with coconut water and high level of BAP (8mg/l), showed negative results in all parameters observed. The experiment is being continued to regenerate plantlets from male flowers and to identify morphological variations through field screening.

Keywords: BAP, kolikuttu banana, coconut water and male bud culture

*Corresponding author: shirani_da@yahoo.com

Bacterial contamination of three commonly consumed raw vegetables from the manning market and six selected supermarkets in the Colombo municipality area, Sri Lanka – A preliminary study

Nandasena A[1,4], Wijesundara C.[2], Chathuranga B.A.G.[3] and Bandaranayaka K.O.[4]*

[1]*Faculty of Health and Life Sciences, Management and Science University, Malaysia*
[2]*Ministry of Health, Colombo, Sri Lanka*
[3]*Department of Medical Laboratory Sciences, Faculty of Allied Health sciences, University of Sri Jayawardenapura*
[4]*Management and Science Institute, Colombo 03*

Leafy vegetables have popular among people around the globe as these vegetables could be consumed with minimal processing. However, they play a major role in transmitting food-borne diseases. This descriptive cross-sectional study was designed to assess the bacterial contamination of commonly consumed vegetables; *Lactuca sativa* (lettuce), *Centella asiatica* (gotukola) and *Brassica oleracea var capitata* (cabbage). Vegetable samples were collected from the Manning market and two randomly selected outlets of three selected supermarket chains; A, B & C located in Colombo 03, Colombo 05 and Colombo 06 respectively in Colombo municipality area, each week for a period of two months. Spread plate method was used for the calculation of viable colony counts and API 20E Enterobacteriaceae identification test aided with gram staining and oxidase test for bacteria identification. Mean colony counts were considerably high in all purchased vegetables from "A", "B" and "C" supermarkets and the Manning market. From the selected three vegetables, highest colony counts were observed from cabbage. Further, all three vegetables showed the highest contamination in supermarket chain "A" while no potentially hazardous organisms were found from supermarket chain "C". More than 80% of the isolated colonies were gram-negative organisms and from these 51.1% were gram-negative bacilli. Furthermore, several bacterial species belonging to families Enterobacteriaceae: *Pantoea* spp., *Enterobacter cloacae, Enterobacter aerogenes* and *Klebsiella* spp. Family Pseudomonadaceae: *Pseodomonas putida;* from Vibrionaceae*: Vibrio fluvialis*and from family Xanthomonadaceae*: Stenotrophomonas maltophilia* were isolated. Presence of Enterobacteriaceae was confirmed; signifying the possible presence of bacterial pathogens in vegetables which could pose a potential health hazard to the consumer.

Keywords: raw leafy greens, minimally-processed vegetables, bacterial contamination and coliforms

*Corresponding author: kalpanee.b@gmail.com

Would biofilm biofertilizer is more useful for okra in sandy regosols

Hettiarachchi C.P.[1], Premamandarajah P.[1] and Seneviratne G.[2]

[1]*Department of Agricultural Chemistry, Faculty of Agriculture, Eastern University, Sri Lanka*
[2]*National Institute of Fundamental Studies, Kandy*

Biofilms are aggregates of multiple microbial communities, attached to each other or to a surface. *In vitro* development and application of biofilms as biofertilizers known as biofilm biofertilizer (BFBF). BFBF is a product which contains beneficial fungal-bacterial colonization in a biofilm mode. BFBF is not only a biofertilizer, but also one of the very effective novel treatment applications which can be used to reduce chemical fertilizer application, improve the crop growth, while recovering soil livability that damaged by conventional agriculture practices. Therefore, This study was conducted to evaluate the effect of BFBF on leaf and pod growth of okra in eastern region, in comparison with fertilizer recommendation of the Department of Agriculture (N, P_2O_5 and K_2O concentration of 150,200 and 75 kg/ha in basal and N and P_2O_5 at 150 and 75 kg/ha in topdressing respectively) and farmer practice at eastern region (basal at 250 kg/ha at 8 days after planting and kalpitty mixture at 50 kg/ha up to 2 months in 10 days interval). The recommendation of Biofilm-veg is 1 L for an acre. 100 ml of Biofilm-veg was dissolved in 16 L of water and this amount was sprayed to 400 m^2. Biofilm-veg was applied with the first and the last application of chemical fertilizers. Eight different treatments consisted of 100% and 50% of DOA recommendation, 100% and 50% of farmer practice, combination of biolilm with 50% DOA recommendation and 50% farmer practice and biofilm alone were replicated four times in Complete Randomize Design. Leaf number and pod number per plant were recorded in 2 weeks interval and data were statistically analyzed using SAS and difference between treatments was compared using Duncan's Multiple Range Test (DMRT). Combination of 50% DOA recommended chemical fertilizer with BFBF significantly increased the no of pods and among the treatments highest value was obtained at 50% DOA+BFBF application. The combination of 50% recommended chemical fertilizers with BFBF can be recommended for okra cultivation in eastern region.

Keywords: biofilm, biofertilizer, microbial functions and BFBF

*Corresponding author: prabuddhachanuka@gmail.com

Foliar application of methanol for mitigation of temperature stress on okra plants

Rasanjali K.G.A.I.*, Kumara R.P.D.N. and De Silva C.S.

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

Temperature stress due to global warming is one of the limiting factors for crop production. Therefore, suitable methods have to be developed to overcome the temperature stress in order to increase production in the unit area. Foliar application of methanol is a method which increases crop CO_2 fixation in unit area and influence on crop yield. The main objective of the study was to evaluate the effect of foliar spray with different concentrations of ethanol on growth and yield of okra under temperature stress conditions. The experiment was done as a factorial based on completely randomized design with three replications at poly tunnel of the Open University of Sri Lanka. Treatments tested in this study were as follows: four concentrations of methanol (0, 20, 25, and 30 (v/v)) and two levels of temperature (ambient temperature ($32^0 – 33^0$ C) / Temperature stress ($35^0–36^0$C). Results revealed that interactions between temperature stress and methanol were significantly different (P≤0.05) in growth and yield traits of okra. Concentrations of 25% and 30% of methanol were positively influenced the plant height, number of leaves, leaf area, chlorophyll content and fresh weight of pods per plant under temperature stress but no significant difference between these two methanol treatments were observed. Therefore, 25% of methanol can be recommended as economically viable concentration at temperature stress to obtain higher yield.

Keywords: methanol, temperature stress, okra and yield

*Corresponding author: rasanjali429@gmail.com

Comparison of *in vitro* hydrolysis rates and amylose contents of fifteen commonly available starch sources in Sri Lanka

Liyanage R.T.P[2]., Sewwandi K[1]., Deen A[1]., Rathnayake I[1]., Jayawardana B.C.[2]* and Liyanage R.[1]

[1]*Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Hanthana Road, Kandy, Sri Lanka*
[2]*Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya*

Physicochemical properties may vary in starches from different botanical sources. Glucose and maltose releasing speed of food during digestion in the body, depends on their physicochemical properties. In this study, fifteen different starch sources; corn, wheat flour, atta flour, palmyrah, blackgram, soybean, white basmathi, red basmathi, white raw rice (Bg 360), red raw rice (at 353), chickpea, kurakkan, oats, kithul and olu were evaluated for their *in vitro* hydrolysis rates and amylose contents. Amylose contents and *in vitro* hydrolysis rates of fifteen starches were determined using Amylose Amylopectin Assay Kit and GOD method respectively. Current study revealed that there were significant differences ($p<0.05$) in amylose contents and *in vitro* hydrolysis rates among starches. In terms of amylose content palmyrah (36.12±0.91%) showed the highest ($p<0.05$) while soybean (7.22±0.92%) showed the lowest ($p<0.05$). However, kithul showed the highest α-amylase enzyme hydrolysis rate (1596.39 µM maltose/min) while white basmathi showed the highest amyloglucosidase enzyme hydrolysis rate (217.54 µM glucose/min) and in both occasions soybean was the least. According to the findings of the present study, considering the two properties together, blackgram, olu, red raw basmathi and soybean with comparatively lower hydrolysis rates and higher amylose contents could be used as better substitutes instead of wheat and white raw rice. Further, the results of this study also would be useful in the developing novel food products to manage and control hyperglycaemia in diabetic subjects.

Keywords: amylose, hydrolysis, *in vitro*, physicochemical and starch

*Corresponding author: baranaj2000@yahoo.com

In vitro prebiotic activity and dietary fiber content of fifteen different starch sources in Sri Lanka

Sewwandi K.[1], Liyanage R.T.P.[2], Deen A.[1], Rathnayake I.[1], Polwattage A.S.[1], Jayawardana B.C.[2]* and Liyanage R.[1]

[1]*Laboratory of Nutritional Biochemistry, National Institute of Fundamental Studies, Hanthana Road, Kandy, Sri Lanka*
[2]*Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya*

Prebiotics and dietary fiber are categorized under the group of functional ingredients which modulates broad range of non-communicable diseases including colorectal cancer, cardiovascular disease, diabetes, and other inflammatory diseases. Aim of the current study was to compare the prebiotic activity and dietary fiber (DF) content of fifteen different types of starch sources (wheat, white raw rice, redraw rice, kurakkan, white basmathi, red basmathi, blackgram, corn, soy, olu, kithul, chickpea, oats, atta and palmyrah) in Sri Lanka. The prebiotic effect was assessed by evaluating the proliferation ability of pure culture probiotic bacteria: *Bifidobacterium animalis* subsp. *lactis* (BB-12) and *Lactobacillus acidophilus* (LA-5) in the presence of each *in-vitro* digested sample. DF content was investigated using enzymatic gravimetric method (AOAC (2012)-991.42). Results revealed that total dietary fiber content (TDF) was significantly different (p <0.05) among flour samples. Soybean showed the highest TDF content (38.65±0.31% dry matter) with the highest insoluble dietary fiber content (32.76±0.16% DM) while the lowest TDF (2.3±0.13% DM) was recorded in wheat flour. When considering about prebiotic activity, olu showed the highest significant growth enhancement (p <0.001) for *Lactobacillus* (1.07×10^8 CFU/ml, 9.07 times growth enhancement compared to oats) and *B. animalis* subsp. *lactis* (7.28×10^7 CFU/ml, 2.03 times growth enhancement compared to oats). There was no correlation between dietary fiber content and prebiotic activity of studied starches. The current study revealed that olu, white basmathi and oats have higher prebiotic activity compared to the other starch sources used in this study and indicating the possibility of using them in functional food preparation.

Keywords: *Bifidobacterium*, dietary fiber, lactobacillus, prebiotic and Sri Lanka

*Corresponding author: baranaj@pdn.ac.lk

Assessment of vocalization behavior of dairy cows in relation to feeding practice as a measure of welfare

Senaratna D*, Senarath D.A.C.S. and Atapattu N.S.B.M.

Department of Animal Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Vocalization of cattle delivers useful information about the caller that can be used to improve management practices and their welfare. Vocal behavior (VB) of cattle gives useful information of their physiological and psychological functioning. The objective of the study was to identify the changes of VB in relation to feeding as a measure of welfare of Jersey x local cross bred dairy cattle. Common behaviors associated with vocalization was observed using an ethogram while intensity of sounds were measured by using a mobile application; a sound meter. Randomized complete block design (RCBD) was used and blocking was done against the parity of milking cows (1st, 2nd and 3rd parity) between aged 4-5 years. Sample size was (n=12). Two treatments were used; before feeding (T1) and after feeding (T2). Behavior study was done by getting direct observations continuously 2 hours/day for 3 months' period either before or after feeding while maintaining the animals in usual herds and in house situation. Same animal group was subjected to the study. Statistical package, SPSS with Mc-Nemar's paired test was used for data analysis. There was a significant difference ($P < 0.05$) between vocalization and feeding time. In relation to feeding, milking cows show a greater number of vocalization in T1 with high average duration (2.9s) compared to T2 (1.5s). Behaviors like interaction with other animals, mouth opening, lying/standing position and urination was significantly ($p<0.05$) affected by T1 and T2. Position and urination showed a significant difference ($P < 0.05$) in T2 compared to T1. It is concluded that changed VB of milking cows can be expected either before or after feeding practice as an indication of welfare.

Keywords: behavior, dairy cattle, feeding, vocalization and welfare

*Corresponding author: dulcy@ansci.ruh.ac.lk

Pathogens associated with sugarcane (*Saccharum officinarum* L.) leaf yellowing and mosaic in Sri Lanka

Gimhani T.D.M.[1], Perera A.M.M.S. [2], Wijesuriya A.[2], Abeysinghe S.[1] and Widana Gamage S.M.K.[1]*

[1]*Department of Botany, University of Ruhuna, Matara, Sri Lanka*
[2]*Division of Crop Improvement, Sugarcane Research Institute, Udawalawa, Sri Lanka*

Leaf yellowing and various patterns of mosaic are common disease symptoms prevailing in sugarcane cultivations in major growing areas, Pelwatta, Sevanagala and Udawalawa in Sri Lanka. Those symptoms resemble to those caused by sugarcane yellow leaf virus (SCYLV), sugarcane mosaic virus (SCMV) and sugarcane streak mosaic virus (SCSMV) reported from other countries. In 2013, we observed previously unreported symptom, yellowing of midrib followed by yellowing of entire leaf lamina from Pelwatta and Udawalawa sugarcane cultivations. Present study was aimed to identify pathogens responsible for leaf yellowing and mosaic diseases in sugarcane using polymerase chain reaction (PCR). Total RNA and genomic DNA from symptomatic tissues were extracted following TRIzol[TM], silica-based extraction and CTAB methods respectively with slight modifications. RNA was amplified with primers for capsid protein gene for SCYLV, SCMV and universal primers for SCSMV (CPF/AP3) using one-step reverse transcription (RT) PCR and confirmed by two-step RT-PCR. For the detection of phytoplasma associated with disease symptoms, genomic DNA was amplified using P1/P7 and PC399/P1694 primers in nested PCR. PCR products with expected size (~500 bp) was obtained only for samples showing light green streak mosaic pattern from Udawalawa. Nucleotide sequences of amplicons were 97-99% identical to SCSMV accessions in the GenBank and was named as SCSMV isolate SRI-SL1 and submitted to GenBank under the accession number MK994186. Briefly, all complete genome sequences of SCSMV in the NCBI database was aligned with SRI-SL1 sequence using ClustalW and phylogenetic tree was generated with 1000 bootstrap replicates using Geneious R11 software. The results showed that Sri Lankan isolate clusters with isolates from India, Iran and Pakistan. Our results confirm that the symptom of light green streak mosaic in sugarcane is caused by SCSMV. Further, phytoplasma are not associated with sugarcane leaf yellowing and mosaic. However, association of SCYLV and SCMV with above symptoms requires further investigation.

Keywords: sugarcane, yellow leaf, mosaic and RT-PCR

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

Assessment of different pretreatment methods to reduce initial microbial load of fresh *Moringa oleifera* Lam. leaves

De Silva E.S.M.* and Jayasinghe J.M.J.K.

Department of Food science and technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The leaves of *Moringa oleifera* Lam. (Moringa) have numerous health benefits due to the rich phyto-nutrients composition and rich content of vital minerals and vitamins. Microbiological safety of fresh Moringa leaves must be ensured to obtain a high-quality leaf powder that is to be used as a raw material in the nutraceutical food industry. This study was aimed to identify a pretreatment method to reduce the microbial load of fresh Moringa leaves. Fresh Moringa leaves were subjected to three different treatments namely soaking in NaCl solutions (1%, 5% and 10%) dipping in H_2O_2 solutions (1%3% and 5%) for 5 minutes and steam blanching for 30 seconds, 45 seconds and 1 minute. The total plate count (TPC) and Coliform count of Moringa leaf samples were measured before and after treatments. The initial TPC and Coliform count of fresh Moringa leaves were ranged from 1.85×10^4 to 5.75×10^5 CFU/g and 2.15×10^2 to 5.15×10^4 CFU/g respectively. The most efficient methods to reduce both TPC and Coliform counts were dipping in 10% NaCl solution for 30 minutes, dipping in 5% H_2O_2 solution and steam blanching for 45 seconds. TPC reduction percentages for these three pretreatment methods were 93.85%, 99.87% and 99.95% respectively. Coliform reduction percentages for these were 98.21%, 96.16% and 100% respectively. Pretreated leaves were dried to make powder and analyzed for proximate composition, phytochemical properties, color properties and functional properties. According to microbiological tests, steam blanching for 45 seconds was identified as the most effective method to reduce both TPC and Coliform count of fresh Moringa leaves.

Keywords: moringa leaves, microbial load, pretreatments and steam blanching

*Corresponding author: jagathj@sci.sjp.ac.lk

Faculty of Science
University of Ruhuna

RISTCON
2020

Investigation of the effect of heavy metals and other physico-chemical parameters for the coloration in water of Kattakaduwa reservoir

Hettiarachchi S.R.[1]*, Samaraweera C.M.D.[2], Edirisinghe E.A.[3] and Brinili A.D.[4]

[1]The Open University of Sri Lanka, Department of Chemistry, Nawala, Nugegoda, Sri Lanka
[2]The Open University of Sri Lanka, Regional Centre, Matara, Sri Lanka
[3]National Water Supply and Drainage Board, Pamburana, Matara, Sri Lanka
[4]National Water Supply and Drainage Board, Regional Laboratory, Nupe, Matara, Sri Lanka

The study was conducted at Kattakaduwa reservoir, Hambantota district, Sri Lanka in 2017 to assess the variation of five heavy metals (Mn, Fe, Cu, Cd and Pb) and seven physico-chemical parameters (dissolved oxygen, pH, temperature, alkalinity, turbidity, conductivity, sulphate ion) throughout the year to narrow down the reason for brown colour fluctuation of reservoir water. Sediment analysis for five selected heavy metals was also carried out. Average water temperature, pH, dissolved oxygen, sulphate concentration, turbidity, conductivity and alkalinity of reservoir water are 32.917 ± 0.229°C, 7.516 ± 0.036, 7.080 ± 0.508 mg/L, 57.42 ± 6.81 mol/m^3, 36.74 ± 5.45 NTU, 605.3 ± 34.6 µS, 175.92 ± 9.32 mg/L, respectively. Corresponding values after purification are 31.667 ± 0.355°C, 7.350 ± 0.028, 8.172 ± 0.195 mg/L, 86.0 ± 10.3 mol/m^3, 1.39 ± 0.26 NTU, 692.8 ± 34.6 µS, 127.3 ± 9.0 mg/L, respectively. Maximum Fe concentration was recorded in March (1.73 mg/L) while minimum was in January (0.712 mg/L) exceeding the US federal limits of Fe (0.3 mg/L) throughout the year. But Mn exceed the US federal limit (0.05 mg/L) only in May (0.053 mg/L), July (0.051 mg/L) and October (0.052 mg/L). The presence of the rest of the heavy metals is negligible. The concentrations of Fe (15291 ± 3598 ppm) in sediments are much greater than Mn (1178 ± 330 ppm), and hence the brown colour in water may be due to adsorbed Fe in sediments, which can easily leach to the water. All concentration values of heavy metals in purified water are negligible.

Keywords: physico-chemical, anoxic and federal limits

*Corresponding author: srhet@ou.ac.lk

Comparison of antimicrobial activities of ethanol, hexane and aqueous extracts of *Epaltes divaricata* against clinical isolates of methicillin resistant *Staphylococcus aureus*

De Zoysa M.H.N.[1], Hasanga M.R.P.[2], Hewawasam R.P.[2]* and Wijayaratne W.M.D.G.B.[3]

[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences, University of Ruhuna
[2]Department of Biochemistry, Faculty of Medicine, University of Ruhuna
[3]Department of Microbiology, Faculty of Medicine, University of Ruhuna

Staphylococcus aureus has developed resistance against commercial antibiotics, mainly β lactam antibiotics, due to their indiscriminate use. Therefore, scientists are in search of potential antimicrobial substances to alleviate this problem. Medicinal plants used in the traditional medicine would be a potential source to explore antimicrobial drugs with novel mechanism of actions. Antimicrobial activity of *Epaltes divaricata* was previously investigated against methicillin sensitive *S. aureus*. The objective of this study was to determine the effect of ethanol, hexane and aqueous extracts of *Epaltes divaricata* (Heen mudamahana) for potential antimicrobial activity against methicillin resistant *S. aureus* (MRSA) isolates. Potential antimicrobial activity of ethanol, hexane and aqueous extracts of *E.divaricata* (whole plant) was analyzed against twenty MRSA isolates obtained from stock cultures of Department of Microbiology, Faculty of Medicine, university of Ruhuna. Antibacterial activity was screened using agar disc diffusion method. Minimum inhibitory concentration (MIC) was determined using five-fold serial dilution yielding seven dilutions of the original plant extract. Vancomycin was used as the positive control. All twenty MRSA isolates gave inhibition zones of 13.1-18.7, 6.7–13.1 and 6.6-15.6 mm for ethanol, hexane and aqueous extracts of *E.divaricata* respectively. MIC of ethanol, hexane and aqueous extracts ranged between 0.019-2.4, 0.012-0.32 and 0.019-0.48 mg/mL respectively. Hexane extract of *E.divaricata* exhibited the highest antibacterial activity compared to the ethanol and aqueous extracts against the MRSA isolates tested in the study. These plant extracts should be evaluated further to isolate active components.

Keywords: antimicrobial effect, *Epaltes divaricata*, *Staphylococcus aureus* and solvents extract of plant

*Corresponding author: ruwaniph@yahoo.com

Use of MaxEnt modeling in determination of distribution of *Calotropis gigantea* plant (Apocynaceae) in Sri Lanka

Wijeweera W.P.S.N.[1]*, De Silva M.P.K.S.K.[1], Dhileepan K.[2] and Senaratne K.A.W.[2]

[1]*Department of Zoology, University of Ruhuna, Matara, Sri Lanka*
[2]*Biosecurity Queensland, Department of Agriculture, Fisheries and Forestry, Brisbane, Australia*

Information on species distribution is essential for biodiversity monitoring and conservation practices. Species distribution is determined by the biotic and abiotic factors, which highly influence on survival of species. *Calotropis gigantea* is a native, medicinal plant having less information on its' distribution in Sri Lanka. Objective of the study was to determine distribution of *C. gigantea* in relation to 18 bioclimatic variables using a novel species distribution modelling technique- MaxEnt. Surveys along roadsides were conducted in 120 sites covering all nine (09) provinces of Sri Lanka from December 2014 to June 2015. Occurrences of the plants were recorded at each site. MaxEnt modelling was carried out using recorded occurrence data and bioclimatic data downloaded from WorldClim database. According to occurrence data *C. gigantea* was found in all provinces except Central province of Sri Lanka. Highest distribution was in coastal regions and the lowest in Western and Sabaragamuwa provinces. MaxEnt modelling also predicted that entire coastal belt, Northern, North-Central and Eastern provinces of Sri Lanka contain the highest probability of *C. gigantea* distribution and low probability of *C. gigantea* distribution in North-Western, Western, Southern, Uva, Central and Sabaragamuwa provinces. The findings of the study provide detailed information on distribution pattern of *C. gigantea* in Sri Lanka and occurrence data could be submitted to Global Biodiversity Information Facility database, which will be greatly important for further studies of *Calotropis* plant. As MaxEnt modelling predicts the areas favorable for the plant growth, it will be useful for conservation process of the plant if needed.

Keywords: calotropis distribution, MaxEnt modeling and species distribution modelling

*Corresponding author: surendi87nisha@gmail.com

Assessment of macro-benthic community in the north region of Negombo estuary in relation to physico-chemical parameters

Oshadi H.D.C.L.[1]*, Jayawardana J.M.C.K.[1] and Mendis B.R.C.[2]

[1]*Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
[2]*Environmental Studies Division, National Aquatic Resources Research and Development Agency, Colombo 15, Sri Lanka*

Environmental changes caused by input of land based pollutants such as domestic and industrial sewage can have detrimental impacts and lead to marked variations in macro-benthic assemblages living in estuaries. With this view, the objectives of this study were to evaluate physico-chemical parameters in water and sediments to assess its suitability for benthic community and to identify key determinants that govern the species diversity in the north region of Negombo estuary. Physico-chemical parameters in overlying water and sediments in six locations in the north region of Negombo estuary were investigated between January and March 2019 and analyzed using appropriate standard techniques. Macro-benthic fauna were also collected from sampling locations and their species diversity and richness were determined. The underlying patterns of variation of sites based on physico-chemical parameters and macro-benthic community composition were examined using multivariate approach. Results of the study revealed that there is an environmental stress for aquatic benthos due to high average Chemical Oxygen Demand (1113 ± 115.09 mg/L), Oil & Grease (1.7 ± 0.52 mg/L), Cadmium (0.05 ± 0 ppm) and Lead (1.41 ± 0.09 ppm) in overlying water as well as high average sedimentary Cadmium (42.08 ± 12.79 mg/kg) and Lead (91.67 ± 54.01 mg/kg) which exceed the permissible levels proposed by CEA, 2017 and Marine/Estuarine Sediment Screening Guidelines, 1995 in respectively. In conclusion, temperature and oil & grease content significantly ($p < 0.05$) contributes to the assemblage differences of macro-benthos in the north region of Negombo estuary.

Keywords: macro-benthos, Negombo estuary, physico-chemical parameters, pollution and water quality

*Corresponding author: chamari.oshadi@gmail.com

Seed oil variation of plantation grown *Santalum album* L. due to selected host and agro ecological variation

Piyarathna P.H.P.[1,3]*, Subasinghe S.M.C.U.P.[1], and Hettiarachchi D.S.[2]

¹Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka
²Wescorp Group of Companies, Western Australia
³Department of Biosystems and Technology, Faculty of Technology, University of Ruhuna, Sri Lanka

Santalum album L. of family Santalaceae is a hemi parasitic plant species, endemic to Sri Lanka, India, and Indonesia. According to the former discoveries of *S. spicatum*, (Australian sandalwood) seed oil is an ironic source of natural and highly stable, Acetylenic fatty acid, and Ximenynic acid which are useful as anti-inflammatory agent to increase dermal micro-circulation and the *Santalum* stem oil quality and quantity vary within local populations due to different host species. Therefore present study was initiated to identify the variation of plantation grown *S. album* seed oil quality, and quantity due to the variations of host species and agro ecological conditions in Godigamuwa (WM3A), Moratuwawala (DL1A), Tangalle (IL1B) and Maho (IL3) representing the dry and intermediate zone of Sri Lanka.

S. album seed samples were collected randomly from the trees grown with different host species, *viz., Sesbania grandiflora, Leucaena leucocephala,* and *Gliricidia sepium in selected* plantations in January 2018. Dbh and height of selected *S. album* trees and host species were measured. Oil of 5.000 g of kernels of each seed sample was extracted by Soxhlet extraction method and gas chromatography was used to identify constituents present and their abundance in seed oil. One way ANOVA was used to analyze the statistical variant. In addition, fatty acid profile and the physio chemical parameters were analyzed and compared with the published data of Australian *Santalum spicatum* seed oil.

The Recent study has identified statistically, there is a significant impact for seed oil yield, protein content, seed oil peroxide value, acid value, free fatty acid value, seed oil fatty acids profile from selected host and agro ecological variation. However, there's no any significance variation in seed oil iodine value, saponification value, and specific gravity due to impact of hosts and agro ecological conditions (F=0.03 p=0.998, F=0.09 p=0.992, and F=0.67 p=0.663) respectively. Result indicated that the seeds of *S. album* are smaller than the seeds of *S. spicatum* and the seed oil yield of *S. album* (*60*-80%) is greater than seed oil yield of *S. spicatum* (35-60%).

Keywords: *Santalum album*, seed oil quality, *Santalum spicatum and ximenynic acid*

*Corresponding author: panchamipiyarathna@gmail.com

Impacts of soil erosion and land use on water quality in Samanalawewa watershed, Sri Lanka

Kumarasiri A.D.T.N.*, Udayakumara E.P.N. and Jayawardana J.M.C.K.

Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

Soil erosion and forest quality are important parameters, which affects the water quality of watershed area. Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Sediment Delivery Ratio (SDR), InVEST Carbon model and Normalized Difference Vegetation Index (NDVI) were evaluated for selected twelve sub-watersheds of Samanalawewa watershed (SWW) with the support of remote sensing (RS) and geographic information system (GIS). Water quality parameters; Temperature, pH, Electrical Conductivity, Total Dissolved Solids, Dissolved Oxygen, Biochemical Oxygen Demand, Alkalinity, Hardness, Nitrate-N, Phosphate-P were analyzed in monthly basis for water samples collected from twelve sampling locations (n=12) in the watershed within month of May to July. Pearson correlation was conducted to establish the relationships between water quality parameters and soil erosion, water quality indicators and forest quality / NDVI of each sub-watershed. The results of the study revealed that the annual total soil erosion rate in the SWW due to current land use and land cover is 139.9 t/ ha/ yr and the average NDVI Values/ forest quality varied from -0.2907 to 0.4628 in sub watersheds. All the water quality parameters in the study area within the standards limits of SLS (614:2013). According to the result of InVEST Carbon model the result of above ground biomass map revealed dominant carbon storage among the other carbon pools. There is no direct relationship between water quality parameters and soil erosion rates and a strongly significant (p<0.05) negative correlation between average NDVI values and nitrate-N (r^2= 0.521, p=0.008) were detected. Soil erosion does not seem to affect water quality in SWW due to the present of a good forest cover. Therefore overall water quality in the study area is in good condition.

Keywords: invest carbon model, invest SDR model, soil erosion and water quality

Antibacterial activity of the partitioned fractions of endolichenic fungus *Xylaria feejeensis* collected from the mangrove plant *Rhizophora mucronata* in Negombo Lagoon, Sri Lanka

Gunawardhana M.H.A.Y, Wicramarachchi S.*, Weerasinghe W.R.H. and Paranagama P.A.

Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka

Endolichenic fungi (ELF) are known for biosynthesizing secondary metabolites with antifungal, cytotoxic, antioxidant and antibacterial activity to protect their lichen against radiation, microbial invasions and harsh surrounding environments. Mangrove plants in Negombo lagoon is a niche for a diverse range of lichens. The ELF, *Xylaria feejeensis* from the lichen, *Graphis librata* which develops on the mangrove plant, *Rhizophora mucronata* in Negombo lagoon was previously isolated and identified by the research group at the University of Kelaniya. The objective of this study was to determine the antibacterial activity of the secondary metabolites of *X. feejeensis*. A pure culture of *X. feejeensis* on potato dextrose agar plates (60) was incubated for 14 days and secondary metabolites were extracted to ethyl acetate by shaking overnight. The ethyl acetate crude extract (5 mg/ml, 100 µL) was subjected to agar well diffusion anti-bacterial assay against *Escherichia coli* (ATCC25922), *Staphylococcus aureus* (ATCC25923) and Bacillus subtilis (ATCC6051) with Azithromycin positive control and it showed above 85% inhibition of growth for all three bacteria. Hence the crude extract (8.58 g) was partitioned in hexane, chloroform and 60% methanol in water (v/v) and tested for antibacterial activity. Hexane fraction showed the highest inhibition of growth of *E. coli* with 100% inhibition and chloroform fraction showed the highest inhibition of the growth of *S. aureus* with 88.5% inhibition whereas methanol fraction showed no antibacterial activity. The results suggest that *X. feejeensis* produces secondary metabolites with high antibacterial activity. Further purification of hexane and chloroform fractions may results in antibacterial drug leads.

Keywords: endolichenic fungi, *Xylaria feejeensis* and antibacterial activity

*Corresponding author: suranga@kln.ac.lk

Maturity and variety dependence of bioactive constituents of Ceylon cinnamon (*Cinnamomum zeylanicum* Blume)

Wijeweera A.A.[1], Madhushika S.[2], Hemalika W.S.[2], Hettiarachchi S.R.[3], Hewage J.W.[2]*, Jayasinghe G.G.[1] and Wijesinghe K.G.[1]

[1]National Cinnamon Research and Training Center, Department of Export Agriculture, Sri Lanka
[2]Department of Chemistry, University of Ruhuna, Matara, Sri Lanka
[3]Department of Chemistry, The Open University of Sri Lanka, Matara, Sri Lanka

Cinnamon has been given a considerable attention owing to its potential applications in the food and drug industry. Amongst all cinnamon species, Ceylon cinnamon has received priority in the world market due to its special characteristics. In this study, the dependence of the bioactive constituents on maturity of two main asexually propagated Ceylon cinnamon varieties, Sri Gamunu and Sri Vijaya from Palolpitiya, Matara was investigated, while maintaining both genetic and ecological variations constant. Forty-eight samples of bark and leaves from three different maturity stages of cinnamon sticks as over 5, 2-2.5 and 1.5-2 years were analyzed in quartets for the determination of bioactive contents quantitatively. It was observed that barks and leaves of both Sri Gamunu and Sri Vijaya species contained alkaloids, saponins, steroids, phenols, flavonoids, oxalates, and tannins as bioactive compounds. Furthermore, the quantitative analysis for the constituents that imparts greatest health benefits proved that the Sri Gamunu variety is the best (alkaloids: 8%, flavonoids: 2%, saponins: 9%, phenols: 5mgTAE/gFW) out of two varieties with higher percentages of bioactive constituents. The study also revealed that the bark of Sri Gamunu variety with about 2 years of maturity gives the highest contents of bioactive compounds.

Keywords: Ceylon cinnamon, bioactive constituents, maturity, cinnamon bark and cinnamon leaf

*Corresponding author: jinasnea@chem.ruh.ac.lk

Impact of agriculture practices on water quality parameters of ground water from Valikamam area in Jaffna district, Sri Lanka

Fasna M.I.F.[1], Prabagar S.[2] and Prabagar J.[1]*

[1]Department of Chemistry, University of Jaffna, Jaffna, Sri Lanka
[2]Industrial Technology Institute, Colombo -07, Sri Lanka

The Jaffna Peninsula largely depends on groundwater resources for domestic as well as agricultural purpose. The quality of ground water is a vital concern for mankind since its directly linked with human welfare. In this study the water quality parameters of ground water were analysed in Valikamam area of Jaffna and samples collected from agriculture wells and domestic wells near the agricultural areas during the period of February 2019 to March 2019. 32 samples were analysed with random sampling for physical characteristics (turbidity, pH, colour, electrical conductivity, salinity, TDS) and chemical characteristics (nitrate, sulphate, phosphate, fluoride, chloride, calcium, magnesium, sodium, potassium, total hardness and total alkalinity). All the samples have higher alkalinity (1069.5 - 494.5 ppm), electric conductivity (5380 S/cm- 675 S/cm) and total hardness (514.56 - 196 ppm) than desirable level compared to Sri Lankan standards (SLS). 87.5% of samples showed higher amount of calcium and 88.2% samples showed high magnesium contents. Sodium, magnesium, salinity, TDS, and chloride contents were found to be very highin samples collected close to sea water. Sulphate (200 – 21.2 ppm) and phosphate (1.24 – 0.02 ppm) contents are found to be within SLS acceptable level but in the case of nitrate, 28.85% of samples exceeded the permissible level (50 ppm) including domestic wells and it was in the range of 5.7 to 93.1 ppm. The wells are in agriculture land as well as domestic wells showed higher content of nitrate. This is due to excessive usage of nitrate fertilizers in the agricultural land where the intensive cultivation is practised throughout the year.

Keywords: ground water quality, physicochemical parameters, drinking water and nitrate

*Corresponding author: j_prabagar@yahoo.co.uk

Phytochemical analysis and antimicrobial activity of different solvent extracts of stem of *Cynanchum viminale* (L.) L. (Muwakeeriya)

Jayamani T.H.P.[1]*, Jeyadevan J.P.[1] and Emmanuel C.J.[2]

[1]Department of Chemistry, Faculty of Science, University of Jaffna, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Jaffna, Sri Lanka

In Sri Lanka, traditional healers use the *Cynanchum viminale* for treatment of various diseases associated with microbial infections. Although medicinal activities of many plants have been well documented in Sri Lanka, there is very less information about *C. viminale*. With this background, the present study aimed to elucidate antimicrobial activity and to analyse phytochemicals of ethyl acetate and water extracts of stem of *C. viminale*. The antimicrobial assays were carried out by agar well diffusion method using crude extracts (100 mg/ 100 µL). Five different bacterial species and three different *Candida* species were screened. Streptomycin sulphate (50 ng/100 µL) and Fungicon (100 ng/100 µL) were used as positive control for bacteria and *Candida* species, respectively. The phytochemical analysis showed positive to tannins, saponins, phlobatannins, flavonoids, cardiac glycosides, alkaloids, terpenoids and steroids. Ethyl acetate extract showed highest activity against the bacteria *Escherichia coli* (ATCC 25922) with diameter of inhibition zones 26.9 ± 1.4 mm and it also showed anti-candida activity against all tested *Candida* species and the highest activity (19.03±0.34) was against *C. krusei*. The present study confirmed the antimicrobial activity of *C. viminale* and revealed the major groups of phytochemicals in the extracts. Further studies are needed to find out the active compounds in these extracts.

Keywords: *Cynanchum viminale,* antibacterial activity, anti-candida activity and phytochemical analysis

*Corresponding author: pavithrajayamani5@gmail.com

Phytochemical screening, profiling and study of antioxidant capacities of fruits of three selected banana varieties

Senarathne H.D.S.[1], Attanayake A.P.[2] and Fernando I.R.[1]*

1Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
2Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka

Unripe fruits of *Musa paradisiaca* possess the AChE inhibitory activity, which enhances the signal transmission time period among neurons by binding with the AChE receptor. Therefore, this research project was focused on the phytochemical screening, profiling and study of antioxidant capacities of fruits of three abundant *Musa* varieties in Sri Lanka, namely, *Musa accuminata* AAA, *Musa accuminata* AAB and *Musa balbisiana* ABB with an intention of investigating their AChE inhibitory activity and potential to treat Alzheimer's lately. The ethanolic and aqueous extracts of each banana variety were prepared by shaking fresh, chopped banana pieces in ethanol and water separately using a shaker for two days at room temperature. Phytochemical screening of each extract exhibits the presence of alkaloids, flavonoids, proanthocyanidins, unsaturated sterols, triterpenes and saponins. The quantitative determination of the total phenolic-, flavonoid-, condensed tannin-, alkaloid- contents and the antioxidant activities were carried out using standard colorimetric assays. Among the three banana varieties analyzed, the ethanolic extract of *Musa balbisiana* ABB indicates the highest total phenolic-, flavonoid- and condensed tannin- contents as 65.86±0.35 mg gallic acid equivalent/100 g, 549.39±11.59 mg catechin equivalent/100 g and 863.49±20.94 mg catechin equivalent/100 g, respectively. The ethanolic extracts of *Musa accuminata* AAB represents the highest total alkaloid content, 11.71±0.35 mg caffeine equivalent/100 g while the ethanolic extract of *Musa balbisiana* ABB indicates the highest antioxidant activity, 35.25±1.99 mgL^{-1}. The studied three *Musa* varieties can be used as potential sources of natural antioxidants.

Keywords: Alzheimer's disease (AD), Acetylcholinesterase (AChE), antioxidant activity, banana varieties and natural products

*Corresponding author: isurika.fernando@sjp.ac.lk

Investigation of adsorption properties of *Alstonia scholaris*, *Pagiantha dichotoma* and *Strychnos nux vomica* barks for some selected amino acids and dyes.

Warnasooriya S.R. and Vithanarachchi S.M.*

Department of Chemistry, University of Colombo, Colombo, Sri Lanka

Saw dust of various tree barks are used as low cost biosorbents. Further, the outer bark of certain tree species is used in treatment of various diseases and snake bites in indigenous medicine. The objective of this study is to investigate the adsorption of amino acids; L-arginine, glycine, L-phenylalanine, and dyes; picric acid, methyl orange, and rhodamine B on saw dust of *Alstonia scholaris* (Rukattana), *Pagiantha dichotoma* (Divi Kaduru), and *Strychnos nux vomica* (Goda Kaduru) under different experimental conditions. The adsorption of selected adsorbates on saw dust of selected tree species was checked by varying pH (4-11), temperature (20-60 ºC), contact time (0.5-3.5 h), initial adsorbate concentration (5-30 ppm) and adsorbent dose (0.5-3.0 g). Results of the adsorption studies revealed that the optimal pH, temperature, contact time, initial adsorbate concentration and adsorbent dose for amino acid adsorption were pH ~7, 30 ºC, 3 h, 10 ppm, and 1.5 g, respectively, whereas that of dyes were found as pH ~10, 40 ºC, 1 h, 10 ppm, and 1.0 g, respectively. Among the three saw dust varieties, *Pagiantha dichotoma* showed the highest adsorption for glycine and L-arginine. *Alstonia scholaris* was the best adsorbent for acidic dyes while both *Pagiantha dichotoma* and *Strychnos nux vomica* were better adsorbents for the basic dye.

Keywords: biosorbent, saw dust, *Alstonia scholaris*, *Pagiantha dichotoma* and *Strychnos nux vomica*

*Corresponding author: sashimv@chem.cmb.ac.lk

Monitoring of aquatic plant growth using satellite images in Bundala national park, Sri Lanka

Chathuranga K.A.M.[2], Rathnamali G.B.M.[1] and Sandamali K.U.J.[1]*

[1]*Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Science and Technology, University of Ruhuna, Sri Lanka*
[2]*Survey Department of Sri Lanka, Kirula Road, Narahenpita, Colombo 05, Sri Lanka*

The rapid utilization of satellites and remote sensing techniques has provided reliable, effective, and near real-time possibilities to characterize terrestrial and adjoining to water bodies as such studies enable precise extraction of said ecosystems from the water body. Features associated with aquatic environment can be classified by applying image classification methods on satellite images. This study aims to separate non floating aquatic plants from other land-use types in the Bundala National Park from 1997 to 2019 in order to monitor and analyze temporal changes of the spatial coverage. Maximum Likelihood Classification method was used to classify the satellite images in Arc Map 10.6.1. Software. The Landsat-5 Thematic Mapper imagery and Landsat-8 Operational Land Imager were used to extract the spatial coverage of the water bodies. Data from ground sampling and high-resolution satellite images from Google earth platform were used for the accuracy assessment. According to the study, there was a noticeable fluctuation in the spatial coverage of water surface and aquatic plant areas, as the study reveals that water areas get reduced by 14.82% while aquatic plant areas get amplified by 20.48% over the water body during the last two decades. The reason for rapid colonization of aquatic plants in Embilikala lagoon (which is one of the three key lagoons of the Bundala wetland system), were found to be as anthropogenic activities such as agriculture.

Keywords: aquatic plants, Bundala, landsat and remote sensing

*Corresponding author: janakisandamali@gmail.com

Management plan for rehabilitation of degrading southern coastal lagoons; new directions for wetland management

Madarasinghe S.K.[1]*, Yapa K.K.A.S.[2], Kodikara K.A.S.[3], Dissanayake N.P.[3], Sripal D.D.N.[3] and Jayatissa L.P.[3]

[1]Department of Biosystems Technology, Faculty of Technology, University of Ruhuna, Matara, Sri Lanka
[2]Department of Physics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
[3]Department of Botany, University of Ruhuna, Matara, Sri Lanka

Coastal lagoons which are among the highest productive ecosystems are being deteriorated worldwide. Kalametiya lagoon in Sri Lanka can be considered as a highly degraded lagoon in this regard and it is now about to disappear due to increased input of freshwater and silt. Similarly, reduction of tidal influx in Garanduwa lagoon due to obstructions to the tidal canal results in large monospecific low saline mangrove stands. Changes in the morphometry of Dondra lagoon is recorded as a result of the impaired inflow and outflow through the lagoon mouth, and the increase of the sediment input to the lagoon. All these examples indicate that conservation and management of coastal lagoons in Sri Lanka have been neglected during 'development' activities in the past. In order to reverse this degradation and restore the systems, the followings are proposed; a) establishment of meandering inflow b) formation of cascade system prior to inlets c) introduction of plant species which have well-developed fibrous root system to inflow channel banks d) manual removal/dredging of accumulated silt e) diverting excess freshwater ways to by-pass the main system. These strategies may prevent/reduce bulky siltation process through sediment trapping and settlement before entering to lagoons (e.g. Kalametiya and Dondra lagoons). In addition, f) opening sandbar (lagoon mouth) and g) widening lagoon mouth can facilitate re-salinization with restoration of ebb-flow system at lagoon mouth (Kalametiya and Garanduwa lagoons). These actions are highly commendable for all three lagoons. It is highly recommended to take relevant institutional coordination in execution of the actions proposed.

Keywords: coastal lagoon, sedimentation, re-salinization and institutional capacity

*Corresponding author: sandunikm89@gmail.com

Carbon sequestration potential of *Typha angustifolia* in Embilikala lagoon in Bundala wetland of Southern Sri Lanka

Madushani K.P.K.[1], Ratnayake R.M.C.S.[1], Dahanayaka D.D.G.L.[2] and Amarasinghe M.D.[1]*

[1]Department of Plant and Molecular Biology, University of Kelaniya, Kelaniya, Sri Lanka
[2]The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Carbon sequestration is one of the major functions of wetlands. Majority of carbon stored in wetland are found in soils as it has a capacity to hold up to 200 times more carbon than the surrounding vegetation. As Bundala wetland (BW) had been visited by a variety of migratory birds in significant numbers, it was declared as the first Ramsar wetland in Sri Lanka. Recent observations unveil that *Typha angustifolia* which is considered as a nauseous plant, is extensively distributed in litoral zone of Embilikala lagoon. This study seeks to investigate the carbon sequestration potential of *T. angustifolia* in Embilikala lagoon in the BW. The lagoon was stratified into three sections as Embilikala North (EN), Middle (EM) and the South (ES), that spreads from inlets to outlet. Soil samples were collected randomly from two depths (0-15cm, 16-30cm, from surface) from areas covered by *T. angustifolia* in each section. Soil samples were also collected from areas without *T. angustifolia* plants, as the controls. Carbon contents were determined by wet oxidation with $K_2Cr_2O_7$ followed by measuring absorbance using UV-Visible spectrophotometer. Results revealed that *Typha* soil contains more carbon (EN=205.55±4.08 t C/ha, EM=102.36±2.42 t C/ha, ES=95.11±0.55 t C/ha) than bare soil (EN=36.25±1.09t C/ha, EM=45.56±0.66t C/ha, ES=46.77±3.07 C/ha) in all sections. *Typha* soil in EN was found to be the section that contains the largest stock of carbon. Bare soil contains more carbon in 0-15cm depth than 16-30cm in all sections. *Typha* soils contain more carbon in 0-15cm depth in EM and ES section while it contains more carbon in 16-30cm depth in EN section. These results implicates that even though *T. angustifolia* is considered as a nauseous plant, its distribution in Embilikala lagoon has a positive impact on carbon retention by the Bundala wetland soils.

Keywords: carbon sequestration, *Typha angustifolia* and Bundala wetland

*Corresponding author: mala@kln.ac.lk

Green corrosion inhibition potential of *Gymnema sylvestre* and *Sargassum* sp. extracts in acidic medium

Patabendige N.M.* and Fernando K.R.

Department of Chemistry, University of Ruhuna, Wellamadama, Matara, Sri Lanka

The corrosion inhibition of mild steel (MS) in acidic medium using *G. sylvestre* and *Sargassum* sp. leaves extracts were investigated by weight loss measurements, linear sweep voltammetry, and Tafel extrapolation studies. Both the extracts showed considerable corrosion inhibition capacity in acidic medium. The optimum concentrations of *G. sylvestre* and *Sargassum* sp. which correspond to the highest inhibition efficiencies were 1200 and 800 ppm respectively. The adsorption data were fitted into Langmuir, Temkin and Freundlich adsorption isotherms and adsorption in the form of physisorption was confirmed by the calculated adsorption Gibbs free energies of about ~ (-20 $kJ\ mol^{-1}$) in both cases. Corrosion potential of the steel substrate in 1.0 mol dm^{-3} HCl is -0.5457 V. In the presence of *G. sylvestre* (800 ppm) and *Sargassum* sp. (1200 ppm), the corrosion potential shifted to more negative values of - 0.5492 and - 0.5539 V. Calculated corrosion current densities from Tafel extrapolation studies in A cm^{-2} are 5.8020×10^{-5} (HCl), 0.9288×10^{-5} (*G. sylvestre*) and 2.0651×10^{-5} (*Sargassum* sp.) indicating a mixed type inhibition. The negative shift of corrosion potential in the presence of these inhibitors has been interpreted in terms of their predominant control over the cathodic reaction. According to the outcome of this study, both *G. sylvestre* and *Sargassum* sp. extracts can be used as potential green corrosion inhibitors in acidic medium.

Keywords: mild steel, corrosion inhibition, weight loss, adsorption and percentage inhibitor efficiency

*Corresponding author: nimesha.patabendige@gmail.com

In vitro assessment of antioxidant, antimicrobial and phytochemical screening of crude methanolic extract of leaves of *Murraya koenigii* growing in Sri Lanka

Abeysinghe T.[1]*, Kumara K.A.H.[1], Alwis D.D.D.H.[1] and Chandrika U.G[2]

[1]*Department of Chemistry, The Open University of Sri Lanka, Nawala, Sri Lanka*
[2]*Department of Biochemistry, University of Sri Jayaawardanapura, Nugegoda, Sri Lanka*

Curry leaves, commonly known as "karapincha" in Sinhala is a fascinating house plant grown in Asia and is native to Sri Lanka, Bangladesh and India. Among many different varieties of curry leaves available in Sri Lanka, Murraya koenigii is the most common belonging to family Rutaceae. Traditionally, M. koenigii has been well known to its health benefits and used in Ayurveda medicine practices in Sri Lanka. They are rich in nutrition owing to the presence of a variety of essential phytochemicals, minerals and trace minerals present in their leaves and seeds. Its antioxidant, antimicrobial and phytochemical screening activities were evaluated in the current study. The methanolic extract demonstrated a significant amount of antioxidant activity (IC_{50} =106.6 ± 4.2µg/ml) in 1,1-Diphenyl-2-picrylhydrazyl (DPPH) assays. Furthermore, the cold methanolic extract contains more or less amount of tannin**s**, flavonoids, phenol**s** and alkaloid**s**. Saponins are absent in *M. koenigii*. Methanolic leaf extract of *M. koenigii* exhibited the highest inhibitory activity against *Staphylococcus aureus* compared to *Escherichia coli* and the zone of inhibition was 6.43 ± 0.06mm and 10.33 ± 0.21mm respectively. These findings revealed that the cold methanolic extract was found to have a good antioxidant activity as well as antimicrobial activities and contain many valuable phytochemicals. This study proves the medicinal values of the plant leaf extracts of *M. koenigii* that could be used as an excellent source of natural bioactive compounds in pharmacology.

Keywords: *Murraya koenigii*, curry leaves*,* antioxidant and phytochemical

*Corresponding author: dtabe@ou.ac.lk

Faculty of Science
University of Ruhuna

R STCON
2020

Effects of gamma irradiation on the growth and yield of green gram *(Vigna radiata)*

Rathnayake H.K.L.M.[1], Pathmathas T.[1], Vengadaramana A.[2]* and Ramalingam A.[3]

[1]Department of Physics, Faculty of Science University of Jaffna, Sri Lanka
[2]Department of Botany, Faculty of science, University of Jaffna, Sri Lanka
[3] Teaching Hospital, Jaffna, Sri Lanka

Gamma irradiation is one of the physical mutagens that widely used for mutation breeding, food sterilization and medicinal healing. Purpose of this study was to stimulate the growth and yield of green gram *(Vigna radiata)* which is very nutritious and great source of protein along with fiber, iron, calcium, phosphorous and many vitamins and also a very important source of protein for vegetarian. In the present study, irradiation techniques were applied to investigate the effect of gamma irradiation on yield, physical and biological characters of green gram plants. Five different strengths of gamma irradiation were applied: 0 (Control); 100; 200; 300; 400 kGy in air. Treated seeds were transferred in pots filled with sterile soil separately. Pots were arranged according to a completely randomized design (CRD) with six replicates. The application of different doses of gamma irradiation showed significant changes in biological (shoot length, shoot length, total chlorophyll content and pH) and physical (reflective index, current voltage characteristics and conductivity) properties of the plants at their 1st harvesting stage. The plants showed gradual increase in root length with increasing dose of gamma irradiation significantly ($P<0.0001$). pH of the plant extracts varied significantly ($p<0.05$) among different treatments. Higher (5.91) and Lower (5.75) pH values were observed in dose 400 Gy and control respectively. Gamma irradiation dosage at 400 Gy resulted in a significant increase in concentration of total chlorophyll content (66.3%) compare to control, suggesting that 400 Gy doses of radiation could activate photosynthetic pigment system. There was no significant difference observed in mass of yield among treatments and the control. Electrical conductivity of plant extracts increased gradually in parallel to the exposure dose. While the resistance and the refractive index exhibited an opposite trend. The present study revealed that the application of different doses of gamma irradiation do not stimulate the yield of the green gram plants and total chlorophyll content is not correlated with the yield.

Keywords: gamma irradiation, total chlorophyll content, reflective index, conductivity and green gram

*Corresponding author: avengad19@yahoo.com

Effect of plant phenolics on physicochemical properties of gelatin films

Panamgama L.A.*, Perera S.A.S.P. and Jayasekara H.D.

Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

This study is an experimental investigation of adding liquefied *pinus radiata* bark extract to gelatin and the development of a new series of biobased polymeric films. A 10 %wt. gelatin filmogenic solution was prepared by adding 2 %wt. glycerol as plasticizer, without and with the addition of pinus radiata bark extracts at 5 to 10 %wt. based on dry gelatin mass content. The films were prepared by the casting technique, at room temperature. All the films were smooth and homogeneous. Neat gelatin films were clear transparent, whereas incorporation of bark extract has changed the colour of films from light yellow to dark brown. Properties of this series of films were characterized using different physicochemical techniques (barrier, thickness swell, water solubility, color, FTIR spectroscopically and morphologically). With the increase in bark extract concentration from 5 to 10 %wt. a gradual increase in the thickness, decremental trend in physicomechanical properties such as swelling, dissolution of films, were observed with compared to neat gelatin films. Further increase in addition of bark extracts has improved higher resistance to water, high relative humidity conditions and lower swelling characteristics. Successful biodegradation of films was further confirmed their potential suitability to be used as alternative to non-biodegradable polymeric materials, for their application in packaging fields. Elimination of traditional non-biodegradable raw materials and value addition to waste are novel concepts.

Keywords: Plant phenolics, films, gelatin and physicochemical properties

*Corresponding author: asoka@chem.ruh.ac.lk

Synthesis of fatty acid diethanolamides from microalgal biomass

Fernando H.S.S.[1], Lakmali W.G.M.[2], Athukorala S.N.P.[2], Jayasundera K.B.[1] and Yapa Y.M.A.L.W.[1]*

[1]*Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka*
[2]*Department of Botany, Faculty of Science, University of Peradeniya, Sri Lanka*

The demand for various synthetic chemicals is continuously increasing in the modern world to produce various consumer products. Currently, petroleum sources provide the precursor compounds for most of the synthetic chemicals. Due to depletion of petroleum resources as well as health and environmental concerns, alternative renewable resources are preferred. In the recent past, microalgae have emerged as a lucrative alternative since they grow fast and do not compete with food supply chains. Further, microalgae exhibit a high lipid content and variety that can be easily utilized to produce precursor compounds for chemical industry. This study was focused on using microalgae isolated from natural water bodies in Sri Lanka to produce fatty acid alkanol amides (FAAAs) to be used as biosurfactants. Four microalgae species namely, *Uronema* sp., *Monoraphidium* sp., *Chlorella* sp., and *Chlorococcum* sp., were selected and cultivated under laboratory conditions. Lipids were subjected to transesterification to obtain fatty acid methyl esters (FAMEs) and FAMEs were subjected to amidation with diethanol amine to obtain fatty acid diethanolamide (FADEAs) either in a two-step process or a tandem process. In two-step process, transesterification was carried out to convert microalgal lipids to FAMEs and separated FAMEs were converted to FADEAs. In tandem process, transfesterification and amidation reactions were carried out concurrently without separating FAMEs. The four microalgal species showed average lipid content of 17 – 18% of the dry biomass and varied as *Uronema* sp. < *Monoraphidium* sp. < *Chlorococcum* sp. < *Chlorella* sp. Further, microalgal fatty acids were successfully converted to FAMEs and FADEAs in the two step process as well as tandem process. Among the above species, *Chlorococcum* sp. and *Chlorella* sp. showed the highest yields for FAMEs and FADEAs.

Keywords: microalgae, lipids, biosurfactants and fatty acid alkanol amides

*Corresponding author: lalithyapa@chem.ruh.ac.lk

Development of a method to calculate muscle resistivity of baseball pitchers

Herath H.M.U.K.K.* and Weerakkody P.P.

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya.

Baseball is a famous game in category of bat and ball section among 18 players. Pitcher is one of the most important players in baseball who throws the ball to the catcher from his mound. Pitchers have to improve their physical qualities such as strength, endurance, speed, coordination and muscle resistivity by doing exercise in order to perform well. Objective of this study is to develop and test a machine which can assess the muscle resistivity. The developed machine has three parts; fabric sensor, Arduino-based circuit and software. Fabric sensor is placed on the throwing hand and the circuit is also secured close to the sensor. When the player starts the machine, a beep sound is heard. Then the player must do the movement. Resistivity values will be counted by the fabric sensor. Counted data is transferred to the software through the Bluetooth module located in the circuit. Software is installed on a phone or a computer. Researcher can obtain a draft report of resistivity capacity of movement. Muscle resistivity of twelve baseball players of the Sabaragamuwa University was measured to verify the accuracy of the measurement output. Recordings were obtained twice from each player and the readings were compared. Paired t-test indicate that there is no significant difference between the two readings obtained from each player verifying accurate measurements of muscle resistivity. The study concluded that reproducible muscle resistivity measurements can be obtained using the newly developed, low cost machine.

Keywords*: baseball, pitcher, muscle resistivity and fabric sensor

*Corresponding author: uherath83@gmail.com

Seasonal variation of biodiversity and rock pool water quality in Wellamadama rocky intertidal zone of Matara, Sri Lanka

Wickramasinghe M.P., Sudarshani K.A.M.* and Wegiriya H.C.E.

Department of Zoology, University of Ruhuna, Matara, Sri Lanka

Intertidal zones are considered as transitional zones that are generally occupied by organisms highly adapted for extremely fluctuating environmental conditions. Objective of current study was to determine whether there were any changes in the distribution of invertebrate macro-fauna and selected water quality parameters in rock pools of Wellamadama intertidal zone during the monsoon period and after monsoon period. The study was conducted in rocky intertidal zone of Wellamadama study area from June to November 2018. Sampling area from the study site was selected in order to represent low, mid and high intertidal zones. Fixed line transect method was applied across the sampling area, perpendicular to the rocky surface from highest high tide level to sea water margin. Four quadrats were randomly placed along the line transect in each zone to collect macro-invertebrates. Water samples were collected from selected rock pools in each zone along the line transect during the low tide. Approximately area of 1250m^2 in Wellamadama site was further observed for macro-algae present beyond the line transect representing intertidal zone. Sampling was done in both monsoon period (June-August) and post-monsoon (September-November). There is a significant difference in pH, conductivity, salinity, dissolved Oxygen (DO), NaCl% and macro-invertebrate species density (P<0.05) between two sampling periods. About 13 species of macro-algae were also identified including *Ulva fasciata, Ulva lactuca, Sargassum sp.,* and *Padina antillarum*. Monsoonal effect on rain pattern and wave action changes cause significant impacts on DO, pH, salinity, conductivity, NaCl% in tidal pools and macro-invertebrate species density in Wellamadama rocky intertidal zone.

Keywords: Wellamadama, South-West monsoon, intertidal zone, water quality and rock pools

*Corresponding author: mangalas@zoo.ruh.ac.lk

RISTCON 2020

Faculty of Science
University of Ruhuna

Foraging behaviour of oriental dwarf kingfisher (*Ceyx erithaca*) in tropical wet evergreen forests of Sabaragamuwa province, Sri Lanka

Chandrasiri P.H.S.P.[1]*, Priyadarshana L. M.[2] and Chandrasiri P.H.B.N.[3]

[1]University of Sri Jayewardenepura, Sri Lanka
[2]Divisional Hospital Kiriporuwa, Sri Lanka
[3]University of Ruhuna, Sri Lanka

Oriental dwarf kingfisher (*Ceyx erithaca*) is the smallest kingfisher species in the South Asia. National conservation status of this species is near threatened (NT). The objective of this study was to determine searching behaviour, attack behaviour, foraging sites, food types and food handling techniques of Oriental dwarf kingfisher. The study was conducted in the Tropical Wet Evergreen Forest of Kiriporuwa village (6°48′53″ N, 80°14′13″ E) in Sabaragamuwa Province, Sri Lanka. This study was conducted from January 2018 to August 2019. Data collection was carried out in three line transects (100 m × 10 m) using binoculars from 0630h to 1830h in two days per month. An ethogram was constructed by using observational data. The behaviours for searching food, attacking food, foraging site, food types and food handling techniques were categorized in 180 foraging observations. Diurnal time duration was divided into two-hour time periods. Time allocation for foraging behaviour was maximum in 0830h - 1030h time period. Flying was the major foraging site movement. There was 43% of successful foraging attacks. Gleaning attack method was used to capture food. They highly utilized the trunks and main branches of trees as foraging substrates. They foraged in the middle position of the trees and very low-density foliage cover was preferred. They consumed insects, millipedes, centipedes, arachnids, molluscs, amphibians and reptiles as food sources. Beating method was the main food handling technique. Adaptation of various diet strategies is the reason for foraging success of this species.

Keywords: foraging behaviour, kingfishers and tropical wet evergreen forests of Sri Lanka

*Corresponding author: spchandrasiri@gmail.com

Effect of the sub-lethal concentrations of urea on the development of endemic arboreal tree frog *Polypedatus cruciger* (Amphibia: Racophoridae)

Senevirathna K.G., Sudharshani K.A.M.* and Wegiriya H.C.E.

Department of Zoology, University of Ruhuna, Matara, Sri Lanka

Declining of Amphibian species has become a worldwide problem today. Habitat fragmentation and alteration, UV radiation, climate change, diseases, contaminants and nitrogenous fertilizers can be considered as the main reasons. Present study was carried out to investigate the effect of urea on the development of the endemic arboreal tree frog *Polypedatus cruciger*. Urea is the most common nitrogenous fertilizer used in the country. Samples of foamy egg masses of *P. cruciger* were collected from sites in Wellamadama, Matara, and Thelikada area, Galle District. The Lethal Concentration (LC_{50}) of urea on 10-day old post-hatched tadpoles was determined using Probit Analysis. After the estimation of LC_{50}, the tadpoles were exposed to three sub-lethal concentrations 7.0 g/L, 7.5 g/L and 8.2 g/L of urea, and the effects on growth and morphology of tadpole stages of *P. cruciger* were studied. The impact of sub-lethal concentrations of urea for the snout-vent length and weight showed significant difference ($p<0.05$) and strong negative correlation (Spearman's rho correlation coefficient= -0.405 and -0.436 accordingly) when compared to the control. The observed external morphological changes under the laboratory conditions included edema formation, abdominal lesions, colour change and rupturing of tadpoles. Since water bodies in agro ecosystems contain diverse fertilizers and pesticides, their impacts on amphibians in the field may be severe due to their synergistic effects. This may cause severe declining in amphibian species, which have their developmental stages associated with water bodies in agro eco systems.

Keywords: urea, *Polypedatus cruciger*, lethal concentration, amphibians and nitrogenous fertilizers

*Corresponding author: mangalas@zoo.ruh.ac.lk

Knowledge and practices regarding usage of sublingual Glyceryl Trinitrate tablets

Thuvaragan S.[1], Coonghe P.A.D.[2], Guruparan M.[3] and Thanujah M.[1]*

1Unit of Allied Health Sciences, Faculty of Medicine, University of Jaffna, Jaffna, Sri Lanka
2Faculty of Medicine, University of Jaffna, Jaffna, Sri Lanka
3Teaching Hospital, Jaffna, Sri Lanka

An effective self-management of symptoms of acute coronary syndrome is a vital skill for maintaining a good quality of life. The poor knowledge on usage of sublingual Glyceryl Trinitrate (SGTN) tablets and the unawareness on calling for help can be detrimental, due to delay in getting treatment when it is urgently needed. The objectives of this study were to assess the knowledge and practices regarding the usage of SGTN tablet and the influence of socio-demographic factors among the patients with coronary vascular disease. A descriptive cross-sectional study was conducted among 256 patients attending Cardiology clinic at Teaching Hospital, Jaffna. An interviewer administered questionnaire was used to collect the data regarding socio-demographic factors, knowledge and practices regarding SGTN tablets. Of the 256 patients, majority (67.2%) were males and the patients' mean age (± SD) was 66 (± 9) years. More than three fourth (77.3%) of the recruited participants had poor knowledge. Educational level had statistically significant association with the level of knowledge (p=0.01). Only 48% of the participants stated that the tablets should be replaced every eight weeks and 81.2% carried their SGTN tablets all the times with them. Females (100%) carried their tablets in an accurate way of protecting it from sunlight and body heat than males (58.7%). The level of knowledge regarding usage of SGTN is needed to be improved by developing and implementing frequent reinforcement of patient education during prescribing and dispensing of SGTN tablets. This will facilitate self-management of acute coronary syndrome.

Keywords*: Sublingual Glyceryl Trinitrate, nitroglycerin, medication and self-administration

*Corresponding author: thanujahmurugathas03@gmail.com

Knowledge and practice regarding multi-dose eye drop usage among glaucoma patients

Rangana Ishara H.M.[1]*, Thuvaragan S.[1], Coonghe P.A.D.[2] and Chandrakumar S.T.S.[3]

[1]Unit of Allied Health Sciences, Faculty of Medicine, University of Jaffna, Sri Lanka
[2]Department of Community & family medicine, Faculty of Medicine, University of Jaffna
[3]Teaching Hospital Jaffna, Sri Lanka

Glaucoma is one of the leading causes of global irreversible blindness. Majority of the people with glaucoma are treated with eye drops. Good knowledge and practices on eye drop usage is important in glaucoma management. This study aims to assess the knowledge and practice regarding multi-dose eye drop usage in glaucoma patients. A descriptive cross-sectional study was conducted among 247 glaucoma patients in the eye clinic in Teaching Hospital, Jaffna during June to July 2019. An interviewer-administered validated questionnaire was used to collect information about socio-demographic factors, knowledge and practice regarding eye drops usage. The collected data was presented using descriptive statistics. Out of 247 participants, 61.5% (n=152) were females. Only 18.2% (n=45) of participants knew that eye drops should be stored in a cool and dry place. Nearly 78% (n=87) of participants believed that two eye drops couldn't be instilled back to back. Nearly 6.5% (n=16) of participants believed medicine could be discontinued without asking the doctor once the symptoms relieved. Only 4.9% of the participants washed their hands before instillation. Only 2.0% of patients press dacryocyst area for 1 minute after instillation. Only 13.4% of participants showed adequate knowledge and only 2.0% showed good practice. This study revealed that the majority of participants had poor knowledge and poor practice regarding eye drop usage. Patients need better education and detailed information about eye drop and its administration. This would help to increase the efficacy of antiglaucoma therapy.

Keywords: glaucoma, knowledge, practice and instillation

*Corresponding author: rangana.ishara93@gmail.com

Patient's views on use of computers in consultation room and its effect on doctor-patient relationship

Madhuwanthi R.M.[1]* and Marasinghe R.B.[2]

*[1]Department of Nursing and Midwifery, Faculty of Allied Health Sciences,
University of Sri Jayewardenepura, Sri Lanka*
*[2]Department of Medical Education and Health Sciences, Faculty of Medical Sciences,
University of Sri Jayewardenepura, Sri Lanka*

Computers play an increasingly prominent role in health information management in health care delivery. The tertiary care hospital under this study has implemented hospital information management system as an Electronic Health Information System (EHIS). The objectives are to describe the patients' perception on use of computers in consultation room and to describe the extent of patient satisfaction towards doctor-patient relationship after using computers in consultation. This is a descriptive cross-sectional study which was carried out among the out-patients over 18 years old, attending to the OPD using consecutive sampling. An interviewer-administrated questionnaire was used to collect data at the consultation room. The mean ($\pm$ SD) age of the participants (n=362) was 41$\pm$13.5 years. Majority were married (n=309, 85%). Half of them were educated up to ordinary level (n=166, 45.9%). Almost all the participants (98%) reported that doctor had given adequate attention to them and had given enough time to discuss their problems with the doctor. Almost all (98%) were on the opinion that entering their clinical details into the computer would benefit them in the subsequent visits in the future. Majority of the respondents (97%) agreed that computer didn't negatively affect their relationship with the doctor and 65% were on the opinion that the new system would improve doctor-patient relationship. Use of computers in healthcare services would be beneficial and it would not negatively affect doctor-patient relationship.

Keywords: Electronic Health Information Systems, Hospital Information Management System and doctor-patient relationship

*Corresponding author: maheshikamaduwanthi144@gmail.com

Mild-stinging jellyfishes reported off coastal waters of Sri Lanka

Karunarathne K.D. and De Croos M.D.S.T.*

Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, Sri Lanka

Cnidarian jellyfishes (medusae) are reported to have both positive and negative impacts on ecological and socioeconomic aspects throughout the world. However, knowledge on the jellyfish in Sri Lankan waters is poor due to lack of literature. A systematic jellyfish survey was carried out in the coastal waters of Sri Lanka from January 2017 to April 2018, and samples were collected using commercial beach seins, scoop nets and zooplankton nets and preserved in 5% formalin/seawater. Meantime, few samples collected by some other local researchers were also received to the Museum of Department of Aquaculture and Fisheries, Wayamba University of Sri Lanka. Non-hazardous species morphologically identified using standard guides and keys are reported here. During the study, *Aequorea pensilis* (*n*=104)*, Cassiopea andromeda* (*n*=23)*, Crambione mastigophora* (*n*=4)*, Eirene ceylonensis* (*n*=30), *Eirene hexanemalis* (*n*=80), *Liriope tetraphylla* (*n*=11)*, Lychnorhiza malayensis* (*n*=25)*,* and *Olindias singularis* (*n*=4) were reported. Moreover, *Cephea cephea* (*n*=1) was reported for the first time in Sri Lankan waters from Great Basses. It was identified with the aid of taxonomic features including the bell of 300 mm in diameter, a large dome at apex, the dome covered with about 30 large, pointed warts, in each octant 8 large velar lappets between two very small ocular lappets, hundreds of long, tapering filaments, and 3 inter-rhopalar canals per each octant. Furthermore, an *Aurelia* sp., two *Malagazzia* spp. and another two *Eirene* spp. were identified only up to the genus level. Findings warrant further studies on socio-economic aspects of mild-stinging jellyfishes off the coastal waters of Sri Lanka.

Keywords: cnidarians, stingers, taxonomy and zooplankton

*Corresponding author: dileepa_dc@yahoo.com

Attitudes towards dispensing errors among state pharmacists and dispensers in Jaffna district

Danapala D.M.S.M.K.[1], Thuvaragan S.[1]*, Surendrakumaran R.[2] and Thiyahiny S.N[2].

[1] *Unit of Allied Health Science, Faculty of Medicine, University of Jaffna*
[2] *Faculty of Medicine, University of Jaffna*

Attitudes towards dispensing errors are important for reducing medication errors and improve pharmaceutical care. This study was conducted to see the attitude of state pharmacists and dispensers in Jaffna district towards dispensing errors and the influencing factors on it. This is a descriptive cross-sectional study. A pre tested, validated self-administered questionnaire was used to collect data. Data were analyzed by descriptive statistics and chi-square test using SPSS version 23. Among 121 participants, 114 (94.2%) participants responded. Mean age of participants was 35.4±8.3 years and most of them were females (60.5%). Of the participants, 41.2% (n=47) of participants were pharmacists and rest were dispensers. Cut off value used for attitude towards dispensing errors was 50%. More than half of participants (61.4%) had positive attitude towards dispensing errors. Factors which influence were assessed by Chi square test and P value > 0.05 was considered as statistically significant. There was no statistically significant influence of socio-demographic factors on attitudes regarding dispensing errors. Among work related factors, position (pharmacist/dispenser) of participants (p<0.001), working experience in current station (p=0.046) and preparing extemporaneous preparation (p=0.02) showed statistically significant association on attitudes towards dispensing errors. Though majority of the pharmacists and dispensers in Jaffna district have positive attitude regarding dispensing errors, it is a necessity to improve attitudes to meet to world standards. Therefore awareness and continuous professional education programmes need to be initiated for pharmacists and dispensers.

Keywords: attitudes, dispensing errors, pharmacists, dispensers and Jaffna district

*Corresponding author: sthuvaragan5@gmail.com

A survey on vocal hygiene practices among female primary school teachers in Minuwangoda educational zone, Sri Lanka

Thilakarathne J.A.L.I. and Jayasena B.N.*

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Kelaniya, Sri Lanka

Teachers are more vulnerable to get voice disorders, as there is an excessive demand of voice to practice. Vocal hygiene is an indirect approach that identifies and prevents the risk factors for voice disorders. This study aimed to survey and describe the current level of vocal hygiene practices among female primary school teachers in Minuwangoda educational zone, and the factors affecting such practices. A descriptive cross-sectional study was implemented using a sample of 123 volunteering teachers. A self-administered questionnaire was used to identify vocal hygiene practices and the factors that may affect those practices. The results revealed that avoid whispering and avoid straining their voice while talking were the only two vocal hygiene practices often used by most participants. A higher portion of the participants was aware of the factors that might affect vocal hygiene practices. 62.6% (n=77) of participants did not answer the open-ended questions related to factors related to vocal hygiene practices. It is concluded that the participants have more vocal abusive habits such as whispering while talking, not avoiding dusty areas, not taking frequent breaks while teaching, not using microphones while teaching, not taking a sip of water while teaching, not inhaling steam once a week and skipping meals. All such habits may damage the vocal folds and can lead to voice disorders. The current research study concluded that teachers are overusing and misusing their voice since they are not used to practice many good vocal hygiene habits like avoiding dusty areas, taking a sip of lukewarm water while teaching and using microphones while teaching. These findings of the study empower speech and language therapists to make the participants aware to prevent from vocal problems and practice good vocal hygiene habits.

Keywords: vocal hygiene practices, female primary school teachers and factors that affect vocal hygiene

*Corresponding author: bandini@kln.ac.lk

Attitudes and knowledge of Sri Lankan speech and language therapists towards stammering

Kumara J.A.L.R., De Silva M.D.K.* and Sivasubramaniam G.

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Sri Lanka

Literature has revealed that many Speech-Language Therapists (SLTs) tend to demonstrate negative stereotypical perceptions towards stammering and People Who Stammer (PWS) despite being professionals responsible for treatment for stammering. Many of them seem to be uncomfortable and less confident in working with PWS. This study aimed to explore the attitudes and knowledge of Sri Lankan SLTs towards stammering, its treatments, PWS, and parents of children who stammer. Survey data of 116 SLTs who completed Clinician Attitudes Towards Stammering (CATS) inventory was analysed. Overall, negative attitudes towards stammering were found despite the acceptance of multifactorial nature of stammering. SLTs demonstrated misconceptions about personality traits of PWS and their parents. Respondents felt confident of their ability to treat PWS effectively. However, they were not comfortable to work with PWS. They recognized parent counselling as a critical factor in the treatment of pre-schoolers and adolescents who stammer. Although teachers were perceived as being accurate in identifying students who stammer, SLTs were not confident in the teachers' ability to handle stammering behaviours and psychological ramifications. Promoting continuing professional development in the area of fluency disorders would be beneficial to both speech and language therapy students and practicing clinicians for eliminating their negative stereotypical perceptions of stammering and to improve their comfort and skills for treating PWS.

Keywords: stammering, speech and language therapists, attitudes and knowledge

*Corresponding author: dumini@kln.ac.lk

Analysis of selected physiological parameters of elite male triathletes in Sri Lanka

Perera M.K.K.* and Weerarathna L.R.N.D.

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, P. O. Box 02, Belihuloya

The aims of this study were to identify the distribution of selected physiological parameters and the relationships of those physiological parameters with elite Sri Lankan triathletes' performance. Twenty elite male triathletes, age (25.6±2.68 years) were randomly selected to this study which was conducted under pre experimental design. The means of training age and resting heart rates (RHR) were 11.2±2.75 years and 43.9±1.62 bpm respectively. The cooper 12 minutes' test, running based anaerobic sprinting test, 35m sprinting test, modified sit & reach test, standing board jump test were performed to identify the mean values of the VO_2 max, peak power output, speed, flexibility, elastic strength of lower limbs and body composition respectively. Bio-electrical Impedance analysis was performed to identify fat mass (FM), fat free mass (FFM) and muscle mass (MM). Descriptive statistics, Pearson Correlation and ANOVA were used to analyse the data. There were strong negative relationships between triathlon performance and maximum power ($R= -0.892$), minimum power ($R= -0.611$), average power ($R= -0.838$) values of peak power, VO_2 max ($R= -0.844$), flexibility ($R= -0.852$) and elastic strength ($R= -0.929$). Moreover, RHR ($R= 0.845$), speed ($R= 0.930$) and FM ($R= 0.572$) had shown strong and moderate positive relationships on performance respectively. There was a significant effect of early engaged event (p= 0.002) on triathlon performance. Furthermore, there was a significant difference of the VO_2 max (p=0.024) between early swimmers (62.23 ml/kg/min) and pure triathletes (57.27 ml/kg/min). The VO_2 max, peak power output, speed, flexibility and elastic strength were found to have a significant impact on triathletes' performance. Moreover, type of early engaged event was a significant determinant of triathletes' performance.

Keywords: Sri Lankan Triathletes, VO_2 max, peak power output and body composition

*Corresponding author: mkkperera.kd@gmail.com

Knowledge and attitudes of caregivers towards Aphasia within the government hospital settings in the Gampaha district: based on Life Participation of Aphasia Approach (LPAA)

Jayarathna T.V.[1]*, Rathnayake S.[1] and Mettananda K.C.D.[2]

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Sri Lanka

Aphasia is an acquired neurogenic language disorder that affect of language. Person with aphasia (PWA) will also get affected due to disruption of communication. Recognizing caregivers' attitudes and knowledge about Aphasia will increase the effectiveness of rehabilitation of aphasia patients. The current study identified the knowledge and attitudes of the caregivers based on 'Life Participation of Aphasia' approach (LPAA). This is a descriptive study done among 35 primary caregivers of the PWA. Participants were presented with an interviewer administrated questionnaire based on of subheadings of LPAA. Majority of the caregivers (22, 64.7%) knew the medical diagnosis. But (68.6%) caregivers never heard the term aphasia. Caregiver's attitudes in participation in life situation skills were given positive results in involvement in daily routines. Thirty-three (94.3%) caregivers think problem-solving skills are the most affected skill in patients. Considering the knowledge about language related impairment, (60%) had accurate knowledge about comprehension skills. Considering about communication and language environment was highlighted, caregivers had inadequate knowledge about the modes of communication. According to the knowledge and attitudes of caregivers about patient's personal identity, most of the caregivers presented inadequate knowledge (>50%) about personality. Study shows a difference in knowledge and attitudes about the LPAA model related information, as there was a discrepancy between actual status and caregivers views. Therefore, it shows the importance of proper education of caregivers when planning treatment for PWA.

Keywords: Aphasia, attitude, caregivers, knowledge and Life Participation Approach to Aphasia (LPAA)

*Corresponding author: saumra@gmail.com

Evaluation of antibacterial activity in *Nelumbo nucifera* white flower

Mohanasundaram T., Wijesekera K.* and Napagoda M.T.*

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

Nelumbo nucifera is commonly known as "Lotus" which is highly valued in aquatic horticulture in Sri Lanka, and broadly used in the Ayurveda and Siddha systems of medicines. Extracts of different parts of this plant have shown different therapeutic effects due to their phytochemical constituents. Aqueous methanolic extracts (80%) of petals and stamens were screened separately for *in vitro* antibacterial activity. Well diffusion method and Muller Hinton Broth (MHB) dilution method in microplates were used to determine Minimum Inhibitory Concentration (MIC) and agar plates were used to determine Minimum Bactericidal Concentration (MBC) against two Gram-positive (*Staphylococcus aureus* and *Staphylococcus saprophyticus*) and two gram-negative bacterial strains (*Escherichia coli* and *Pseudomonas aeruginosa*). Vancomycin and ceftriaxone were used as the positive controls for gram positive and gram-negative microorganism, respectively and DMSO (dimethyl sulphoxide) as negative control. Petal and stamen extracts showed somewhat similar antibacterial activity, where the zone of inhibition (mm) was higher for gram-negative organisms (14.3 ± 0.6) than gram-positive organisms (11.7 ± 0.6). Methanolic extract of white lotus petals and stamens showed comparatively good antibacterial activity against all four organisms. Results emphasized that lotus flower extracts have the potential to be used as antibacterial agent and the importance of the use of natural products to treat pathological conditions.

Keywords: *Nelumbo nucifera*, well diffusion method, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC) and dimethyl sulphoxide (DMSO)

*Corresponding authors: kdwijesekera@gmail.com; mayurinapagoda@yahoo.com

A cross-sectional study of popularity and usage of skin care products among users in Gampaha district, Sri Lanka

Edirisinghe J.U., Napagoda M.T.* and Wijesekera K.*

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

Industries offer a vast range of skincare products (SCPs) to maintain and improve the general appearance of the skin. Currently, consumers are moving towards herbal-based cosmetics even though there are several synthetic products in the market. Improper usage of cosmetics may lead to health issues like rashes, hair loss, and severe allergic reactions. To evaluate the knowledge, attitudes, and practice of skincare products, a descriptive cross-sectional study was conducted. An interviewer-administrated questionnaire was distributed in the Gampaha district. Out of 424 participants, 234 (55.2%) responded as they used skincare products. Therefore, these 234 participants were taken for further analysis. From the whole population, 44.8% of participants have used synthetic SCPs, 19.8% have used herbal SCPs while 35.3% claimed the use of both synthetic and herbal SCPs. More than 50% of participants among the users were knowledgeable about pH, SPF (sun protection factor), chemical composition and the amount to be used. Most of users believed that SCPs are highly effective and trustable. Participants who use herbal SCPs have believed in the safety and fewer side effects of those products compared to the participants who used synthetic SCPs. In addition, a substantial number of people are ready to accept herbal formulations upon scientific validation of their efficacy and safety.

Keywords: Skin Care Products (SCPs), Herbal based cosmetics, SPF (Sun Protective Factor) and Cross-sectional study

Faculty of Science
University of Ruhuna

RISTCON
2020

Peri-domestic factors associated with transmission of cutaneous leishmaniasis in selected areas in Hambantota district, Sri Lanka

Sudarshani K.A.M.[1]*, Eswaramohan T.[2], Murugananthan A.[3] and Wegiriya H.C.E.[1]

[1]Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka
[3]Department of Parasitology, Faculty of Medicine, University of Jaffna, Jaffna, Sri Lanka

Cutaneous leishmaniasis (CL) is a notifiable disease in Hambantota district and aim of this study was to identify the peri-domestic environmental factors, which attributed potentially to increase CL cases in Hambantota. CL suspected patients who attended to the Tangalle Hospital from June 2016 to January 2017 were interviewed using a questionnaire. Information on the presence of other CL patients in neighbourhood, owned land area, presence of trees, unutilized lands, forests, paddy fields and other agricultural lands, water bodies and distance from patient's house to them were recorded from each patient. Positivity of CL was detected by the presence of *Leishmania* amastigotes in slit-skin smears from skin lesions of each patient. Out of 314, 183 (58.92%) patients were CL positive. Out of 182 positive patients, 49.4% (N=90) had family members or neighbours or co-workers that infected with CL during last five years period. The size of the land of 54.2% (N=64) CL patients were >1000 m^2 (P<0.0001). Most of these lands were covered with tall trees and small plants. Majority of patients (N=116, 99.1%) dumped their garbage (N=56, 42.4%) and wastewater (N= 79, 58.1%) to the open land < 100 m from their houses. Present findings revealed that distance of houses of noticeable number of CL patients were <100 m to unutilized lands (N=104, 68.9%), shrub jungles (N= 92, 60.9%), agricultural lands (N= 48, 31.4%), forests (N= 26, 17.1%) and water bodies (N=24, 15.8%). Therefore, it can be concluded that CL positive patients in this study profile are living close to (less than 100m) previously infected CL patients and habitats preferred by the CL vector for their resting, feeding and breeding.

Keywords: cutaneous leishmaniasis, environmental factors, *Leishmania* and lesion smear

*Corresponding author: kamansuda@yahoo.com

Blood parasites and blood cell analysis of dogs reported to veterinary clinics in selected areas in Matara district, Sri Lanka

Wijesingha H.M.N.P., Sudarshani K.A.M*. and Wegiriya H.C.E.

Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Dogs acts as reservoir host or intermediate hosts for number of disease cycles which seriously affect humans. Present study aimed to identify the common blood parasites found in dogs to determine presence of various species of blood parasites and blood cells with skin type (damaged or non-damaged) of dogs in Matara area. Blood samples were collected from 30 stray and pet dogs and tested for blood parasites. RBC, WBC and Platelets of blood samples were counted using the haemocytometer method. Findings of the present study showed that out of 30 dogs, 9 (30%) had damaged skins when they were present to the veterinary clinics in Matara area. Only *Babesia* spp. (11.10%) was found in blood smears of dogs with damaged skin. *Babesia* spp. (19.10%) and microfilaria of *Dirofilaria* spp. (19.10%) were detected in blood smears of dogs with undamaged skin. According to the findings, mean value of RBC in damaged skinned dogs (1.0504×10^7) was lower than the dogs of undamaged skins (1.1417×10^7). Mean values of WBC and platelets were higher in dogs with damaged skin (4.8061×10^4, 9.5311×10^6 respectively) than in dogs with undamaged skin (2.6260×10^4, 6.2700×10^6 respectively). These differences were not statistically significant. Findings of the present study indicate the possibility of association of blood parasites with the skin type of dogs and further studies are needed for the confirmation of these findings.

Keywords: blood parasites, dog, RBC, WBC, platelets, *Babesia* spp. and *Dirofillaria* spp.

*Corresponding author: kamansuda@yahoo.com

Reconstructing an image from its spatial and geometrical information

Pasindu R.* and Mayurathan B.

Department of Computer science, University of Jaffna, Jaffana, Sri Lanka

Nowadays, researches are very much interested to reconstruct images using its local image features. The local feature descriptor with their corresponding geometrical information is very helpful to get the related patch from the original image database. An approach for reconstructing images based on its local feature descriptors and its geometric information is proposed here. The external image database and database of feature descriptors are maintained in this proposed approach to reconstruct any image patch during the testing time. Local feature descriptors with the spatial coordinates, orientation, scale information of the region of interest and index of the source image are used to generate a database of feature descriptors. Nearest neighbor descriptor is identified by using Pairwise matching and identified nearest neighbour descriptor is used to extract the suitable image patch from the original image database. Also, Mean Squared Error (MSE) is used to find out the overlapping areas of patches between the new patch that we want to add and patch already existing in the query image. In our experimental design, the upper threshold value of MSE is set as the default threshold (DT) in order to reduce overlapping patches. Based on our testing outputs, this proposed approach progressively develops an approximation of the unknown image by constructing its region of interest one by one.

Keywords: image reconstruction, SIFT feature and mean squared error

*Corresponding author: kamansuda@yahoo.com

Enhancing the performance of convolutional neural networks based on preprocessing of datasets

Priyatharsan U.* and Hemija Sarawana P.

Unit of Information & Communication Technology, SVIAS, Eastern University, Sri Lanka

Image Recognition is a very challenging task in the various field of computer vision. Convolutional neural networks (CNN) has led to very good performance on a variety of problems in the fields of visual recognition. Although CNNs have achieved great success in experimental evaluations, there are still lots of issues that deserve further investigation. In this research, we proposed a method to improve the performance of a convolutional neural network based on preprocessing of the training and testing sets. We used three different databases Oliva & Torralba, ImageNetDogs and Caltech 256 to train three well-known CNNs AlexNet, GoogleNet and ResNet. Highest performance were obtained to the 70/30 ratio for the training and test set, when the Oliva & Torralba database were used with grid method. Two types of tests were conducted; first test with standardization which limits the all classes of the database to the class that contains the minimum amount of images, and second test with complete database. Results showed that standardizing a database lowers performance. Further, in test 1, it can be seen that the recognition rate for the class with the highest number of samples in Caltech 256, *Clutter,* was lower and on the contrary, the success rate for classes with fewer samples such as the *golden-gate-bridge, harpsichord, scorpion-101, sun ower-10, top-hat* were high. Which confirms that the bias towards the *Clutter* class is diminishing. Test 1 increased the success rate of 106 classes, while decreased for 143 classes. This proved that the best results in terms of performance are obtained when complete databases are used.

Keywords: convolutional neural networks, image recognition and data preprocessing

*Corresponding author: tharsan1499@gmail.com

A classifier ensemble model for music emotion classification

Charles J.* and Lekamge L.S.

Department of Computing and Information Systems, Sabaragamuwa University of Sri Lanka

Computational modelling of music-emotion has attracted an increasing attention especially in today's digital age. Even though the use of conventional machine learning algorithms for music-emotion classification are frequently reported in literature, the studies frequently use western/western classical music while traditional melodies like Sri Lankan folk music remains less explored. Therefore, we considered a Sri Lankan folk music dataset introduced by the authors in a previous study, comprising of 206 stimuli (30 seconds, 44100Hz; stereo; 32bit; .wav). The stimuli were purposely composed and orchestrated to express happy (54), sad (70), or fear (82) as predominant emotions and the emotion-annotation was by a panel of musicologists. Twenty-two features related to dynamics, rhythm, timbre, pitch, and tonality were extracted using MATLAB MIRToolbox. Five individual classifiers (Logistic Regression (LR), Naive Bayes, Decision Tree, Random Forest (RF), and k-Nearest Neighbor (k-NN)) were applied on the dataset. K-NN outperformed the others yielding an accuracy of 78.44% with 76.19% and 73.42% for RF and LR respectively. Above classifiers were considered in an ensemble model using Max-voting. Results were enhanced with ensemble boosting techniques (AdaBoost, Gradient Boosting, and XGBoost). With optimized features, AdaBoost (RF) yielded the highest accuracy (95.23%) while reducing the classifier training time significantly. The classifier outperformed the state-of-the art results, but a direct comparison was not possible due to the discrepancies brought by individual datasets, listener populations, etc. in each study. Utilizing features such as Mel-frequency cepstral coefficients (MFCCs) and Deltas of MFCCs which are predominantly used in emotion recognition literature are looked forward.

Keywords: music emotion classification, machine learning, ensemble classifier and max-voting and boosting

*Corresponding author: jcharles@std.appsc.sab.ac.lk

User-friendly mobile-based application for agricultural activities in Sri Lanka

Gunawardana D.A.Y.K., Walisadeera A.I.* and Madushika M.K.S.

Department of Computer Science, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Sri Lanka is an agricultural country and 28.4% of the total labor force of the country is engaged with agricultural activities. Technology has impacted on day-to-day activities and the usage of smart phones has made people's lives easier than before with the innovative technologies. Famers, Agriculture Instructors (AIs) and others in agriculture sector use smart phones for handling and managing their agricultural activities. Several mobile-based applications have already been introduced to Sri Lankan agriculture community. Lacking a standard user-friendly User Interfaces (UIs) is the biggest challenge in those applications. Therefore, it is very difficult to farmer to access the information from it. We developed a mobile-based application that is focused on several activities such as: selecting suitable crops to grow in specific area, managing every step in crop life cycle, weather information, disease identification and treatments and supply and demand model for crops, etc. For each aspect, different user-friendly UIs are designed. Initially, the information needed to create the application was gathered from farmers and AIs from Welimada and Nuwara Eliya areas. Gathered information was analyzed and that identified the farmers need the information based on their context and not in general format. Based on that, different UIs were designed for each purpose. The designed UIs were tested with farmers and AIs as trials. According to their comments and feedback, some of the UIs were eliminated and others were refined. This was repeated for several times with farmers and AIs. Using the UI and UX (User Experience) theories, and considering the standards and common features of mobile applications, the user-friendly mobile UIs were designed and then the mobile application was developed.

Keywords: UI/UX, mobile interfaces, mobile-based application and agriculture

*Corresponding author: walisadeeraa@gmail.com

Customer churn prediction model in mobile telecommunication using machine learning

Chathuranga L.L.G.[1]*, Rathnayaka R.M.[2], Arumawadu H.I.[3], and Chathurangi K.A.A.[1]

[1]*Department of Computing and Information Systems, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
[2]*Department of Physical Sciences and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
[3]*Dialog Axiata PLC, Colombo, Sri Lanka*

Customers are the center of all focuses on almost every industry that offers products and services. Successful business practitioners are those who understand their customers and fulfill their needs. For that, customer churn prediction is significant. Customer churn measures the number of users leaving the service provider. The primary aim of the study is to develop a novel customer churn prediction model for Sri Lankan Telecommunication Company by considering some soft factors for the early identification of customers who leave the service provider. Core relation analyzes with heat map used to feature selection. Three machine-learning algorithms, namely Logistic Regression, Naive Bayes and Decision Tree, are used in this study. Indeed, twenty attributes are mainly carried out to train these three algorithms. Furthermore, the Back propagation Neural Network was trained to predict customer churn. In neural network training; the result of three machine learning algorithms previously mention, and eight attributes that are most affected to final results are used as inputs. The data set used in this study contains 3,334 subscribers' details. The trained Neural Network has two hidden layers, with 25 total neurons. The first and second hidden layers have 15 and 10 neurons, respectively. The performances of the models are evaluated by using the confusion matrix. Final Neural Network model gives 96.7% accuracy in the testing process. The estimated results suggested that the proposed algorithm gives high performances than traditional machine learning algorithm.

Keywords: algorithm, machine learning, neural network and data mining

*Corresponding author: chathurangagihan39@gmail.com

Challenges in the present public transportation system in Kilinochchi

Randeniya R.D.S.S.[1], Perera W.U.L.D.P.[1] and Anburuvel A.[2]*

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

Kilinochchi, a town in northern Sri Lanka, is a sparsely inhabited region with widely dispersed residential areas. At present, public transport in Kilinochchi mainly comprises of bus transit operated only along the main roads due to limited bus fleet and capacity. Due to spatial dispersion of residences, the present bus service is hardly accessible by the passengers and thus, a great majority accesses the existing bus transit via para-transit, private vehicles which are relatively expensive or by walking. This study investigates the possibility of introducing an alternative transport mechanism using a survey on present public transport passengers. The questionnaire survey was done on 516 bus passengers (41% of the total passengers) and the results exhibit poor accessibility of the present bus transit: more than 29% have direct access and 11% of the passengers have access with egress distances of 1.5 km or more and 19% pay Rs. 150 or above when using egress modes. A bus passenger volume survey done on the major corridor revealed that during morning peak hours, 37% buses operate at full capacity or over. The findings of the study, therefore, emphasizes a revisit of the present local bus transit in the context of rerouting and rescheduling. The study suggests to explore the possibility of introducing Demand Responsive Transportation (DRT) with flexible scheduling and routing to satisfy spatially and temporally scattered passenger demand.

Keywords: demand responsive transport, public transport, para – transit, bus passenger volume and bus passenger interview

*Corresponding author: aanbu007@eng.jfn.ac.lk

Intraframe image processing algorithm for identifying meteors in all-sky images

Alahakoon A.G.P.D.[1], Amaradasa H.D.S.[1], Prasadh K.V.S.[1], Vidanagamachchi S. M.[2], Wickramage N.M.[1] and Mahanama G.D.K.[1]*

[1]Department of Physics, University of Ruhuna, Matara, Sri Lanka
[2]Department of Computer Science, University of Ruhuna, Matara, Sri Lanka

An all-sky camera comprises of 180-degree field of view fisheye lens is used in this study to capture the images of meteors. An algorithm has been developed to analyze long-exposure all-sky images by using OpenCV and Python. The algorithm is specially designed to minimize the false detection rate with increasing data volume and to convert all-sky images to grayscale. A threshold limit is applied to find continuous pixel areas. This process allows to find the minimum bound rectangle and to calculate the ratio between short and long edges. Rectangles having ratio under a predefined value are statistically defined as meteors and are saved in memory. This process reduces false detections. The algorithm has been tested repeatedly to conclude its capability to detect bright meteors successfully using one or sequence of long-exposure all-sky images.

Keywords: All-sky camera, image processing algorithm, intraframe, long exposure and meteor detection

*Corresponding author: mahanama@phy.ruh.ac.lk

A fast and efficient random flicker detection system based on a novel low-pass quadrature filter

Ajward A.M.*

Department of Engineering Technology, University of Ruhuna, Kamburupitiya, Sri Lanka

Many known literature techniques are available to detect flicker in electric power systems and to mitigate them. However, they are not suitable to detect random flicker in the presence of the higher-order harmonics. This is mainly due to their slowness in the flicker detection process, and thus, significant detection inaccuracies result. Therefore, a new low-pass quadrature-filter based fast and efficient technique is proposed here for detecting flicker, especially, random flicker under higher-order harmonics. By setting a proper low-pass cutoff frequency, the new technique can filter higher-order harmonics efficiently without any additional filters. It can quickly detect the random flicker amplitudes using shorter filter lengths with a detection error of less than 2%. This performance is confirmed using simulated flicker for different amplitudes and frequencies. In the new technique, the orthogonal-phase of the discrete-time flicker is calculated by convolving a new impulse response function with a novel low-pass quadrature filter response to suppress the higher-order harmonics and to detect the flicker.

Keywords: voltage-flicker, quadrature-filter, detection error and harmonics

*Corresponding author: ajwardma@gmail.com

Photoanode with hybrid TiO₂ nanoparticles/hierarchically structured TiO₂ microspheres for efficient dye-sensitized solar cells

Senthuran S.[1,2,3*], Dissanayake M.A.K.L.[1] and Senadeera G.K.R.[1,4]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*
[3]*Department of Physics, University of Jaffna, Sri Lanka*
[4]*Department of Physics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*

Among various components of a dye-sensitized solar cell (DSSC), the photoanode plays an important role in the overall power conversion efficiency as both dye adsorption and electron transport take place in the photoanode. A typical photoanode of DSSC is fabricated with nanoparticles of a semiconductor metal oxide such as TiO₂ having diameters in the range 10 - 20 nm. Therefore, overall light scattering in the device is poor due to inefficiency of scattering by these nanoparticles. In order to enhance the light absorption within the photoanode by scattering effect, we have successfully fabricated hybrid TiO₂ nanoparticles (NP) /hierarchically structured TiO₂ microspheres (MS) photoanode to achieve higher efficiency through improved light harvesting. This was achieved by incorporating hierarchically structured TiO₂ microspheres into the P25 TiO₂ nanoparticle layer. The highest power conversion efficiency of 7.17 % was achieved for the cell with 10 wt % MS incorporated photoanode which is superior to that of the pristine P25 NP-photoanode based cell with efficiency 6.34 %. The diffuse reflectance measurements and current density-voltage measurements revealed that the improved efficiency is mainly attributed to the increase in photocurrent generation due to the enhancement in light absorption by improved scattering effect.

Keywords: dye-sensitized solar cells, photoanode, hierarchical structure, TiO₂ microspheres and light scattering

*Corresponding author: senthur803@gmail.com

Low cost counter electrode for dye-sensitized solar cells using activated coconut shell charcoal with jackfruit latex as the binder

Dissanayake P.N.[1,2], Kumara G.R.A.[1], Karunarathne D.G.B.C.[1], Kumarasinghe K.D.M.S.P.K.[1] and Sirimanne P.M.[2]*

[1]National Institute of Fundamental studies, Hanthana Road, Kandy, Sri Lanka
[2]Department of Science and Technology, UvaWellassa University, Passara Road, Badulla, Sri Lanka

Dye sensitized solar cells (DSSCs) belong to the third generation photovoltaic cells, can also be used to convert visible light into electrical energy. In this type of DSSCs, counter electrode plays a vital role in photovoltaic performance. As the manufacturing cost of platinum electrodes are very high the present study proposes to fabricating an electrode using activated coconut shell charcoal bonded with jackfruit latex. Coconut shells were fired and activated by sending steam at 900 ^{0}C. Prepared activated charcoal powder was mixed with jackfruit latex solution and sprayed on top of a FTO glass plate to fabricate a counter electrode. Photo-performance of TiO_2|dye|electrolyte (I^-/I_3^-) form solar cells were studied in this work using Mercurochrome as the dye. Maximum efficiencies of 1.845% and 1.384% were achieved for platinum and activated coconut shell charcoal bonded with jackfruit latex electrodes, respectively.

Keywords: coconut shell, jackfruit latex, solar cell and electrode

*Corresponding author: psirimanne@hotmail.com

ZnS buffer layer for CdS/CdTe based solar cells – A preliminary study

Madhuwanthi H.M.L.U.[1], Mahanama G.D.K.[2]* and De Silva D.S.M.[1]

[1]*Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka*
[2]*Department of Physics, University of Ruhuna, Matara, Sri Lanka*

Among thin film solar cell materials, cadmium sulphide (CdS) has to been found to be the most suited window material as a heterojunction partner in cadmium telluride (CdTe) based solar cells. By introducing a buffer layer to the heterojunction, the efficiency of the solar cell can be enhanced. The present study focus on identifying optimum conditions for electrodeposition of zinc sulphide (ZnS) buffer layer for CdS/CdTe solar cells. This study revealed that, the electrolytes containing 0.1 mol/L $Na_2S_2O_3$ and 0.1 mol/L $ZnSO_4$ within the pH range of 4.00-4.50 at 30 ℃ can be used for electrodeposition of ZnS thin films on Florine doped SnO_2 (FTO) coated soda lime glasses at potentials between [(-1000) -(-1200)] mV. The developed materials were characterized using UV-visible spectrophotometry and scanning electron microscopy (SEM) techniques. The optical absorption measurement shows a low light absorbance within the range of (3.60-3.70) eV and SEM studies demonstrate the uniform distribution of ZnS grains on the FTO glass substrate.

Keywords: electrodeposition, zinc sulphide, cadmium sulphide and cadmium telluride

*Corresponding author: mahanama@phy.ruh.ac.lk

A preliminary study on adverse health impacts due to occupational noise exposure in teaching environment

Perera T.C.I.[1] *, Abeysuriya U.I.P.[2], Amarasingha N.D.[1], Sethunga S.M.N.[1] and Bodhika J.A.P.[1]

[1]*Department of Physics, University of Ruhuna, Wellamadama, Matara, Sri Lanka*
[2]*Department of Otolaryngology, Teaching Hospital, Karapitiya, Sri Lanka*

Long-term exposure to occupational noise may cause various physiological, psychological and behavioral problems in workers. This study investigates health impacts on primary school teachers from occupational noise in primary school classes. The results presented here are based on investigations done on 37 randomly selected primary school teachers in Galle district. A questionnaire was used to gather relevant information directly from them. B&K Type-2250 handheld analyzer was used to measure noise levels in school classrooms. "Amplaid A321" audiometer was used to obtain the audiograms of Air Conduction (AC) and Bone Conduction (BC) measurements. Sound Pressure Levels of classrooms during the teaching hours are found to be between 72 to 75 dB(A). The results predicts that 96.77% of sample is having some hearing loss while 93.33% of them may suffer from "Sensorineural hearing loss". Correlation coefficient predicts a positive and moderate relationship between the noise-exposed service period and hearing threshold of the left and right ears. The results indicate further that increase of time period of service exposed to noise, has a significant effect on the increase of hearing threshold, which reflects decrease in hearing ability.

Keywaords: noise exposure, hearing loss, primary school teachers and health impacts

*Corresponding author: isarangaperera@gmail.com

Construction of a nichrome based hot-wire anemometer

Kankanamge B.L. and Jayatilleke K.P.S.*

Department of Physics, Faculty of Science, University of Ruhuna, Sri Lanka

The Hot Wire Anemometer is a device to measure velocity of a fluid. A small electrically heated wire is exposed to flowing fluid medium. Heat of the wire is transferred to the fluid and the change of resistance of the wire can be used as a measure of the velocity of the fluid. Platinum and Tungsten are the mostly used material for the hot-wire, but the cost of the instrument can be very high.

In this research project, a constant current hot-wire anemometer was constructed using low-cost nichrome wire of 1 cm long in the probe. A wind generator and Kestrel 4500 anemometer were used to calibrate the device. Voltage readings were recorded using PASCO Capstone software. Collected data of wind speed versus corresponding voltage across hot-wire was fitted to a formula for estimating the parameters of the formula. Wind speed is obtained from the fitted parameter values.

The constructed anemometer is capable of recording voltages and time and measuring wind speeds in the range 1 - 9 ms^{-1}. The range can be extendable. The device was tested with the normal wind variations in the outside environment. Data were collected for about 30 minutes in the outside environment and wind speed obtained from the calibration curve was plotted with the time. The wind speed was measured using the Kestrel 4500 anemometer in the same day during the same time interval. The results obtained from the laboratory and field experiments showed that the constructed anemometer is operating well.

Keywords: hot-wire anemometer, wind speed and nichrome

*Corresponding author: sunil@phy.ruh.ac.lk

Noise level measurements at Matara city

Amarasingha N.D.[1]*, Thilakarathna D.M.D.N.[1], Rathnayaka R.M.B.D.[1], Sethunga S.M.N.[1], Bodhika J.A.P.[1] and Dharmarathna W.G.D.[1]

[1]*Department of Physics, University of Ruhuna, Wellamadama, Matara, Sri Lanka*
[2]*Department of Botany, University of Ruhuna, Wellamadama, Matara, Sri Lanka*

Rising traffic noise, due to rapidly increasing traffic density in urban cities in Sri Lanka, is becoming a severe problem, especially, for residents and workers in cities. High noise exposure causes mental and physical disorders. Noise exposure above 85 dB for 8 hours frequently could cause permanent hearing loss. The traffic noise patterns throughout the day at three locations in Matara city, close to the bus stand, base hospital and Matara Bodhiya, are presented here.

The traffic noise, continuously for 15 minutes at each hour from 6.00 am to 6.00 pm, on three days per week for three weeks at three locations were measured and analyzed. The noise level (L_{Aeq}) was measured using a B&K Type-2250 handheld analyzer (IEC 61672-1; 2002 Class 1) with essential calibrations. Handheld analyzer mounted on a tripod about 1.2 m above the ground level, to reduce the Ground Effects, was fixed about 8 m away from the middle of the road in taking measurements. Noise level at all three locations remains between 72-78.2 dB throughout the period of study and more than 75 dB for 10 hours per day, which is much higher than the recommended day time level of 63 dB for a urban areas and 50 dB for silent zones like hospitals, public libraries and schools by the National Environmental Act (No 47, 1980).

Workers in the area can be severely affected due to high noise exposure. The hearing level of such workers must be monitored frequently. The results suggest that necessary regulations must be imposed to control the sound pollution. Furthermore, local authorities must take necessary mitigation actions to establish suitable sound barriers, such as such vegetation barriers, wall-type barriers and to develop overpass/underpass for pedestrian crossing and to improve the road condition for smooth traffic flow.

Keywords: traffic noise, noise exposure time and hearing loss

*Corresponding author: andhanushka31@gmail.com

Granger causality between dengue and climatic variables in Colombo, Sri Lanka

Attanayake A.M.C.H.[1]*, Perera S.S.N.[2] and Liyanage U.P.[1]

[1]*Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka*
[2]*Research & Development Centre for Mathematical Modelling, Faculty of Science, University of Colombo, Sri Lanka*

Dengue is a viral infection which is spreading rapidly all over the world as well as in Sri Lanka. The burden of the dengue shown by the number of deaths from the disease annually. Literature shows that there is a strong association between climatic factors with the dengue. This study applied Granger Causality test in order to identify significantly influence climatic variables on reported dengue cases. Data consists with minimum temperature, maximum temperature, rainfall and dengue cases in the Colombo from January 2009 to October 2017. The original series which were not stationary were become stationary after taking seasonal and non-seasonal first differences. Then the stationarity of the final four series were confirmed by applying autocorrelation/partial autocorrelation function, Augmented Dickey-Fuller Test, Phillips-Perron Root Test and KPSS Test. The optimal lag selection in the Granger test was identified using Akaike Information Criterion. In addition to the Granger test, Impulse Response Function and Forecast Error Variance Decomposition were used to study the impact of climatic variables on dengue. Analysis displayed significant correlations of dengue with mentioned variables at 5% significance level. But only the rainfall was granger caused dengue at 5% significance level. Thus, results revealed that even though the variables were correlate, the impact of rainfall on dengue cases was only significant but not the minimum and maximum temperatures; as those are not causing factors for the dengue. Further the impact of rainfall on dengue reaches its peak around 8th week and reaches zero after 20th week. This study provides a platform for identifying influencing variables on dengue which can use to build an effective mathematical/statistical model of the dengue.

Keywords: climatic factors, dengue and granger causality

*Corresponding author: succ@kln.ac.lk

Evaluating the profitability of licensed commercial banks in Sri Lanka

Kumarihamy A.W.M.S.N.[1]* and Perera S.S.N.[2]

Department of Mathematics, University of Colombo, Colombo, Sri Lanka

This study aims to evaluate the profitability of Licensed Commercial Banks (LCBs) in Sri Lankan context by using benchmark method. For the study, eight LCBs in Sri Lanka were selected as the sample. Data were collected from quarterly reports from 1st quarter of 2012 to 2nd quarter of 2018. Return on Assets (ROA) was selected as dependent variable which is one of the key indicators of banks profitability while seven bank specific factors were selected as independent variables. A quantitative approach was followed in the research including descriptive analysis, correlation analysis and regression analysis by using Microsoft Excel Data Analysis Tool Pack. According to the study, Deposit to Total Liability Ratio, Debt to Asset Ratio, Deposit to Asset Ratio and Bank Size are the factors affected for bank profitability. A benchmark to evaluate profitability was developed by using a trend line equation to average ROA values for selected period.

Keywords: profitability, licensed commercial banks, return on assets and benchmark

*Corresponding author: elsac94@gmail.com

146

Application of Markov random fields in image restoration

Bandara S.M.G.S. and Yapage N.*

Department of Mathematics, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Image restoration has been a popular field for decades. Images are destroyed when exposed to 'noise' which can occur due to physical contact or electrical/electronic interference. In this study, Bayesian statistical technique and Markov random field (MRF) theory were used to restore a black and white binary image corrupted by additive Gaussian noise with zero mean and constant variance. The binary image was used as a Markov random field. An image is comprised of pixels and these pixels have a regular two-dimensional lattice structure. A matrix including ±1 values was generated randomly. It was used as an Ising model (±1) in Statistical Mechanics. The Ising model (±1) under Markov property was used as the Ising prior (a Gibbs or Boltzmann distribution) which is the prior distribution of Bayesian technique. Likelihood function was obtained by using the random matrix and the observed corrupted image. Markov Chain Monte Carlo (MCMC) method was used to simulate posterior distribution which again turns out to be a Gibbs or Boltzmann distribution. More specifically, Metropolis-Hastings algorithm which is one of the popular MCMC algorithms was used in this simulation. In this study Peak Signal to Noise Ratio (PSNR) and Mean Squared Error (MSE) methods were used to measure the quality of restored images. MATLAB (R2013a (8.1.0.604)) has been used to construct the program in this research work. When noise was increased the restored-image quality was decreased. When image size was increased a higher number of iterations were required to obtain an acceptable level of quality in the restored image.

Keywords: image restoration, Markov random field, Ising model, Markov chain Monte Carlo and Metropolis-Hastings algorithm

*Corresponding author: nihal@maths.ruh.ac.lk

A study on economy of fish harvesting in Sri Lanka

Lakmali T.H.R.* and Shanthidevi K.C.N.

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka

In this work we were used Logistic Growth Model and Surplus Yield Model to inspect the economics of harvesting in Sri Lanka. The objective of this study is to determine an optimal harvesting quantity which fulfills the economic goal of the harvester while maintaining the population density over pre - specified minimum viable level throughout the harvest. That is how the farmers can get the maximum profit through the harvest by using their maximum effort by not damaging the fish population.

The statistics data for this paper are provided by Ministry of fisheries and Aquatic Resources Development and the boat owner who is working at Hikkaduwa fishing pier. According to the relevant calculations of the data sets during the period of 2009 to 2017 and graphs plotted, cost versus effort and revenue versus effort it can be concluded that, in Sri Lanka still unable to reach the maximum sustainable yield and if we can increase the effort then we can get maximum sustainable yield. The findings can accommodate fish farmers to increase the supply to meet the demand for fish.

Keywords: constant, proportional and periodic harvesting, continuous and discrete, logistic growth model and economic

*Corresponding author: ruwani.luck@gmail.com

On forecasting ability of the artificial neural network model in time series data: Based on gold price in Sri Lanka

Gunarathna I.G.I.S.C. and Nandani E.J.K.P.*

Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Forecasting is the prediction of values of a variable based on known past values of that variable or other related variables. Forecasts also may be based on expert judgments which in turn are based on historical data and experience. Artificial Neural Network (ANN) is a powerful data mining tool that can capture and represent complex input-output relationships. In this study, the forecasting ability of ANN model with standard Back-propagation learning algorithm and trial-and-error observations in time series data has been analyzed based on gold price in Sri Lanka for a period of three years from 2014 to 2017. Comparing ANN model output and actual output via plots and measuring Mean Square Error (MSE), we conclude that number of inputs effects to the time series data forecasting in an ANN model and forecasting ability decreases with increasing the number of forecasting days. Therefore, n^{th}-day forecasting by changing the input-output data patterns: past 30 day values and n^{th}-future day value as input and output data respectively, is better if need to forecast several future days.

Keywords: artificial neural network, back-propagation algorithm, forecasting, time series data and gold price

*Corresponding author: nandani@maths.ruh.ac.lk

Estimation of the size of the stray dog population, case study for the Dickwella divisional secretariat, Matara, Sri Lanka

Sudarshani E.G.D.[1]*, Malkanthi S.H.K.[2] and Jayasekara L.A.L.W.[1]

[1]Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka
[2]Department of Animal Production and Health, Sri Lanka

Stray dogs have become a huge social and health problem in Sri Lanka. An accurate estimate of stray dog population size can be used in conducting investigations, planning control programmes for the stray dog population, estimating the amount of money to be allocated for these programmes and ensuring their success. Limited methods are used to estimate stray dog population size in the literature. Mark and recapture method is the most commonly used method. In the present study, the size of the stray dog population in Dickwella divisional secretariat, Matara, Sri Lanka was estimated using the maximum likelihood method. There are 48 Grama Niladhari (GN) divisions in Dickwella divisional secretariat and five of them were randomly selected for this study.

The size of the stray dog population was estimated and there were 3465 (95 % Confidence interval: 2312-4618) stray dogs in Dickwella. The stray dog population density and the estimated ratio of the human to stray dog population were 69.31 km^{-2} and 15.8:1 respectively.

According to the literature, the ratio of the human to the dog population and human to the domestic dog population in Sri Lanka are 6.7:1 and 9.6:1, respectively. According to these ratios and the human population in Dickwella, there should be approximately 2465 stray dogs in Dickwella. Further this value is within the estimated confidence interval (95 % Confidence interval: 2312-4618). Therefore, the maximum likelihood method is applicable to estimate the stray dog population in Dickwella. The accuracy of the result can be further enhanced by increasing the sample size.

Keywords: stray dogs, population size and maximum likelihood method

*Corresponding author: egdsudarshani@gmail.com

List of Reviewers - RISTCON 2020

1. Dr. Abeyratne M. K., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
2. Dr. Alwis G., Department of Anatomy, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka
3. Prof. Alwis P. L. A. G, Department of Agriculture Engineering, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka
4. Dr. Amarasinghe N., Department of Pharmacy, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya, Sri Lanka
5. Prof. Aponsu G.M.L.S., Department of Physical Sciences and Technologies, Faculty of Applied Science, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
6. Dr. Arasaretnam S, Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
7. Dr. Arazo R.O., University of Science and Technology of Southern Philippines (USTP), Moscat, Claveria, Misamis Oriental, 9004 Philippines.
8. Dr. Atapattu K.S.S., Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Sri Lanka
9. Dr. Bandupriya D., Department of Plant Sciences, Faculty of Science University of Colombo, Colombo, Sri Lanka
10. Prof. Barkhouse W., Department of Physics, University of North Dakota, Witmer Hall Room 218, Grand Forks, ND 58202-7129.
11. Prof. Bulugahapitiya V.P., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
12. Dr. Caldera H. I. U., Department of Plant Sciences, University of Colombo, Colombo, Sri Lanka.
13. Prof. Chandana E.P.S., Department of Biosystems Technology, Faculty of Technology, University of Ruhuna, Matara, Sri Lanka
14. Dr. Chandrasekara N. V., Department of Statistics and Computer Science, University of Kaleniya, Kaleniya, Sri Lanka
15. Prof. Dahanayake N., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka
16. Dr. Dayananda T.G., Department of Botany, University of Ruhuna, Matara, Sri Lanka
17. Dr. De Mel W. A. R., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
18. Dr. De Silva D.S.M., Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka

19. Dr. De Silva G.S.Y., Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Galle, Sri Lanka

20. Dr. De Silva L.N.C., School of Computing, University of Colombo, Colombo 07, Sri Lanka

21. Prof. De Silva M.P.K.S.K., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka.

22. Prof. De Silva P.M.S.C.S., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

23. Dr. De Silva R.C.L., Department of Chemistry, University of Kelaniya, Sri Lanka

24. Dr. Deepananda K.A.M., Department of aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

25. Dr. Dissanayake A.S., Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

26. Dr. Dissanayake N.P., Department of Botany, University of Ruhuna, Matara, Sri Lanka

27. Dr. E.P.N. Udayakumara, Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa Univeristy of Sri Lanka, Belihuloya, Sri Lanka

28. Dr. Edussuriya M., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka

29. Prof. Fernando I.M.K., Department of Physics, University of Colombo, Colombo, Sri Lanka

30. Dr. Fernando M. C. S., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

31. Dr. Fernando T., School of Electrical Engineering and Computer Science, Queensland University of Technology, Brisbane, Autralia.

32. Dr. Ganegoda N. C., Department of Mathematics, University of Sri Jayewardenapura, Gangodawila, Nugegoda, Sri Lanka

33. Dr. Gangabadage C.S., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

34. Dr. Geekiyange S., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

35. Mrs. Geethika, T. D.G., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka

36. Dr. Geremew A.Y., Faculty Biological Science and engineering, Vrije Universiteit, Brussels, Belgium

37. Dr. Goonetillake M.D.J.S., School of Computing, University of Colombo, Colombo 07, Sri Lanka

38. Dr. Gunarathne A.M.T.A., Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
39. Mr. Gunasekara R.D.A, Department of Botany, University of Ruhuna, Matara, Sri Lanka
40. Prof. Gunawardena S., Faculty of Medicine, Department of Physiology, University of Ruhuna, Galle, Sri Lanka.
41. Prof. Gunawickrama K.B.S., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
42. Dr. Guruge W.AH.P., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
43. Prof. Halwathura R.U., Department of Civil Engineering, Faculty of Engineering, University of Moratuwa, Moratuwa, Sri Lanka
44. Dr. Hameed P.N., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka
45. Dr. Hansameenu W. P. T., Department of Mathematics, University of Kaleniya, Kaleniya, Sri Lanka
46. Dr. Hemalika W.S., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka
47. Dr. Hemamali K.K.U., Department of Botany, University of Ruhuna, Matara, Sri Lanka
48. Dr. Herath S. S., Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Sri Lanka
49. Prof. Hettiarachchi S., Faculty of Applied Sciences, University of Rajarata, Mihinthale, Sri Lanka
50. Dr. Hettihewa S.K., Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka
51. Dr. Hewaarachchi A., Department of Mathematics, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
52. Dr. Hewage J.S., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka
53. Prof. Hewage J.W., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
54. Prof. Hewawasam R.P., Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka.
55. Prof. Hung C. H.J., Department of Environmental Engineering, National Chung Hsing University, Taiwan
56. Dr. Ilayperuma T., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka
57. Dr. Indika W.A., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

58.   Dr. Jayakody S., Department of Community Medicine, Faculty of Medical Sciences, University of Sri Jayawardanapura, Nugegoda, Sri Lanka

59.   Dr. Jayananda M.K., Department of Physics, University of Colombo, Colombo. Colombo, Sri Lanka.

60.   Prof. Jayantha P. A., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

61.   Dr. Jayasekara H.D., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka

62.   Prof. Jayasekara L. A. L. W., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

63.   Dr. Jayasinghe J.M.S., Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

64.   Dr. Jayasinghe S., Faculty of Technology, University of Ruhuna, Kamburupitiya, Sri Lanka

65.   Prof. Jayasinghe S., Faculty of Medicine, Department of Pharmacology, University of Ruhuna, Galle, Sri Lanka.

66.   Dr. Jayasundara D. D. M., Department of Statistics and Computer science, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka

67.   Dr. Jayasundara K.B., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Lanka

68.   Mr. Jayathunga E.H., Department of Electrical and Information Engineering, Faculty of Engineering, University of Ruhuna, Galle, Sri Lanka

69.   Dr. Jayatilleke K.P.S., Department of Physics, University of Ruhuna, Matara, Sri Lanka

70.   Prof. Jayatissa L. P., Department of Botany, University of Ruhuna, Matara, Sri Lanka

71.   Dr. Jayaweera C.D., Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayawardenapura, Nugegoda, Sri Lanka

72.   Dr. Jayaweera H.H.E., Department of Physics, University of Colombo, Colombo, Sri Lanka

73.   Dr. Jeewanie J.A., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

74.   Dr. Jinadasa K.B.S.N., Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka

75.   Dr. Kaliyadasa P.E., Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Budulla, Sri Lanka

76.   Dr. Kalutharage N. K., Department of Chemistry, University of Ruhuna, Matara, Sri Lanka.

77. Mrs. Kalyani M.A., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

78. Dr. Karunathilake N. G. A., Department of Mathematics, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka

79. Mrs. Kaveevendan K., Department of Botany, Faculty of Science, Eastern University, Sri Lanka.

80. Dr. Kodikara K.A.S., Department of Botany, University of Ruhuna, Matara, Sri Lanka.

81. Dr. Kodikara M.S., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka

82. Dr. Koneswaran M., Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka

83. Prof. Kottegoda N., Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayawardenapura. Nugegoda, Sri Lanka

84. Dr. Kudavidanage E. P., Department of Natural resources, Faculty of Applied Science, Sabaragamuwa University, Belihuloya, Sri Lanka

85. Dr. Kumara M.P., Faculty of Fisheries and Marine Science, Ocean University, Tangalle, Sri Lanka

86. Dr. Kumara N.T.R.N., University of Brunei Darussalam, Brunei

87. Mr. Kumara W. A. A. U., Ocean University Sri Lanka, Tangalle, Sri Lanka

88. Dr. Kumari W. G. S. M., Department of Botany, University of Ruhuna, Matara, Sri Lanka

89. Dr. Lanel G. H. J., Department of Mathematics, University of Sri Jayewardenapura, Gangodawila, Nugegoda, Sri Lanka

90. Prof. Lenora R. S. J., Faculty of Medicine, Department of Physiology, University of Ruhuna, Galle, Sri Lanka

91. Dr. Liyanagae G., Faculty of Medicine, Departmet of Pharmacology, University of Ruhuna, Galle, Sri Lanka

92. Mr. Lorensuhewa S.A.S., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

93. Dr. Madushika M.K.S., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka

94. Dr. Mahanama G.D.K., Department of Physics, University of Ruhuna, Matara, Sri Lanka

95. Prof. Maithreepala R A., Department of Limno and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

96. Prof. Manatunge J., Department of Civil Engineering, Faculty of Engineering, University of Moratuwa, Moratuwa, Sri Lanka

97. Dr. Mannakkara A., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

98. Dr. Masakorala K., Department of Botany, University of Ruhuna, Matara, Sri Lanka

99. Dr. Mohotti A.J., Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka

100. Dr. Mohottige R., Department of Physics and Astronomy, Rutgers, The State University of New Jersey, 136 Frelinghuysen Road, Piscataway, NJ 08854-8019 USA.

101. Prof. Munasinghe D.H.N., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka.

102. Dr. Nanayakkara C. M., Department of Plant Sciences, University of Colombo, Colombo 03, Sri Lanka

103. Dr. Nandani E. J. K. P., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

104. Dr. Napagoda M. T., Faculty of Medicine, Department of Biochemistry, University of Ruhuna, Galle, Sri Lanka.

105. Dr. Nazim K., Society for Environment and Mangroves Protection, Pakistan.

106. Dr. Nisantha K. A., Department of Economics, University of Ruhuna, Matara, Sri Lanka

107. Dr. Pallegedara A., Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka

108. Prof. Panamgama L.A., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

109. Prof. Paranagama P. A., Department of Chemistry, University of Kelaniya, Sri Lanka

110. Mr. Pathirana D.K., Lakvijaya Power Station, Ceylon Electricity Board, Norochcholai, Sri Lanka

111. Prof. Pathirana H.M.K.K., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka

112. Prof. Peiris D., Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

113. Dr. Peiris H.H., Department of MLS, Faculty of Allied Health Sciences, University of Ruhuna, Matara Sri Lanka

114. Prof. Perera B., Faculty of Medicine, Department of Community Medicine, University of Ruhuna, Galle, Sri Lanka.

115. Mr. Perera C. D., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

116. Dr. Perera H.A.D.S.D., Department of Physics, University of Ruhuna, Matara, Sri Lanka

117. Dr. Perera S. S. N., Department of Mathematics, Faculty of Science, University of Colombo, Colombo 03, Sri Lanka

118. Dr. Perumpuli P.A.B.N., Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka

119. Dr. Pethiyagoda K., Department of Community Medicine, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka

120. Dr. Phattarapattamawong S, Department of Environmental Engineering, King Mongkut's University of Technology Thonburi, 126 Pracha-Utit Rd., Bangmod, Tungkru, Bangkok 10140 Thailand.

121. Dr. Piyaratne M.K.D.K., Computer Unit, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka

122. Dr. Piyatilake I. T. S., Department of Computational Mathematics, Faculty of Information Technology, University of Moratuwa, Moratuwa, Sri Lanka

123. Dr. Pradeep B. G. S. A., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

124. Dr. Pradeep E. K. C., Department of Biosystem technology, Faculty of Technology, University of Ruhuna, Matara, Sri Lanka

125. Dr. Prasangika K. D., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

126. Dr. Prashantha M.A.B., Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayawardenapura, Sri Lanka

127. Prof. Premachandra W.T.S.D., Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

128. Dr. Premarathne U., Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.

129. Prof. Priyangani R. A. S., Department of Economics, Faculty of Social Sciences, University of Kaleniya, Kaleniya, Sri Lanka

130. Dr. Rajapaksha S. M., Department of Engineering Technology, University of Sri Jayawardanapura, Sri Lanka

131. Dr. Ranasinghe P. G. R. S., Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

132. Dr. Ranasinghe P., Herbal Technology Section, Industrial Technology Institute, Halbarawa Garden, Malabe, Sri Lanka

133. Dr. Ranathunga N. P., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

134. Mr. Ranawaka P., Department of Spatial Studies, Faculty of Built Environment and Spatial Studies, General Sir John Kotelawala Defence University, Southern Campus, Sooriyawewa, Sri Lanka

135. Dr. Ranawake A.L, Dept of Agric Biology, Faculty of Agriculture, University of Ruhuna, Sri Lanka.

136. Prof. Ranawake A. L., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

137. Dr. Ranaweera A.S., Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka

138. Dr. Rathnaweera P.B., Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Sri Lanka

139. Dr. Rathnayaka R. M. K. T., Department of Physical Sciences, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

140. Dr. Rathnayake A., Department of Bio-processing technology, Faculty of Technology, University of Rajarata, Mihinthale, Sri Lanka

141. Dr. Rathnayake N., Earth & Ocean Sciences, School of Natural sciences, National University of Ireland, Galway, Ireland

142. Prof. Rathnayake R. M. U. S. K., Department of Food Science and Technology, Faculty of Applied Science, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

143. Dr. Rathnayeka R.M.A.I, Department of bioprocess technology, Faculty of Technology, Rajarata University of Sri Lanka, Sri Lanka

144. Prof. Ratnasekera D., Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

145. Dr. Rumisha C., Solomon Mahlangu College of Science and Education, Sokoine University of Agriculture, Morogoro, Tanzania

146. Dr. Samarathunga D. M., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

147. Prof. Samaraweera G. C., Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

148. Dr. Sanjaya H.L.K., Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.

149. Dr. Senanayake S., Faculty of Medicine, University of Colombo, Colombo 03, Sri Lanka

150. Dr. Senevirathne W.S.M., Department of Food Science and Technology, Faculty of Applied Science, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

151. Dr. Seneviratna K.D.M.N., Department of Interdisciplinary Studies, Faculty of Engineering, University of Ruhuna, Matara, Sri Lanka

152. Dr. Seneviratne D., School of Electrical Engineering and Computer Science, Queensland University of Technology, Brisbane, Autralia

153. Dr. Seneviwickrama K.L.M.D., Department of Community Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

154. Mrs. Shanthidevi K. C. N., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
155. Dr. Sirimuthu N.M.S., Department of Sports Science, University of Sri Jayawardanapura, Nugegoda, Sri Lanka
156. Dr. Siriwardena Y., Department of Parasitology, Faculty of Medicine, University of Colombo, Colombo 03, Sri Lanka
157. Dr. Sivakumar S., Department of Civil Engineering, Faculty of Engineering, University of Jaffna, Jaffna, Sri Lanka
158. Dr. Somathilake L. W., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
159. Prof. Sonnadara U., Department of Physics, University of Colombo, Colombo 03, Sri Lanka
160. Dr. Sultanova M., Odessa College, 201 West University Blvd., Odessa, TX 79764 USA
161. Dr. Tushara C., Department of Civil and environmental Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Galle, Sri Lanka
162. Dr. Vidanagamachchi S.M., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka
163. Dr. Vithanarachchi S.M., Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka
164. Dr. Vitharana V.H.P., Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Badulla, Sri Lanka
165. Mr. Waidyarathna K.M.G.T.R., Advanced Technological Institute, Labuduwa, Galle, Sri Lanka
166. Dr. Walpita J. K., Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka
167. Dr. Wanigatunga R., Department of Plant Science and Molecular Biology, University of Kelaniya, Kelaniya, Sri Lanka
168. Dr. Wanniarachchi S., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
169. Dr. Wannige T., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
170. Mr. Warnasuriya T.W.S., Faculty of Fisheries and Ocean Science, Ocean University, Tangalle, Sri Lanka
171. Prof. Wedagedara J. R., Simcyp-CERTARA Ltd. 2 John Street, United Kingdom S2 4SU.
172. Dr. Weerasinghe A.R., University of Colombo School of Computing, Colombo 07, Sri Lanka
173. Dr. Weerasinghe S., Department of Sports Science, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, sri Lanka

174. Prof. Wegiriya H.C.E., Faculty of Science, Department of Zoology, University of Ruhuna, Matara, Sri Lanka

175. Mr. Welgama W.V., University of Colombo School of Computing, Colombo 07, Sri Lanka

176. Dr. Wickramasinghe M., Department of Computation and Intelligent Systems, University of Colombo School of Computing, No. 35, Reid Avenue, Colombo 07, Sri Lanka

177. Dr. Wickramasinghe N.D., Faculty of Medicine and Allied Health, Department of Community Medicine, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka

178. Prof. Wickramasinghe N.C., 24 Llwynypia Road, Lisvane, Cardiff CF14 0SY,UK

179. Dr. Wickramasinghe S., Faculty of Applied Science, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka

180. Dr. Wickramasuriya N.T., Department of Physics, University of Ruhuna, Matara, Sri Lanak

181. Dr. Wijayaratne W.M.D. G. B., Department of Microbiology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

182. Dr. Wijekoon W. M. C. J., Department of Soil Science, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Matara Sri Lanka

183. Dr. Wijesinghe C., Faculty of Medicine, Department of Community Medicine, University of Ruhuna, Galle, Sri Lanka

184. Mrs. Wijesinghe C. R., University of Colombo School of Computing, Colombo 7, Sri Lanka.

185. Prof. Wijetunga S., Department of Agriculture Engineering, Faculty of Agriculture, University of Ruhuna, Kampurupitiya, Sri Lanka

186. Mr. Wijeweera K. R., Deaprtment of Computer Science, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

187. Dr. Wijeyaratne W. M. D. N., Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka

188. Dr. Wijeyaratne W. M. D. N., Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya Kelaniya, Sri Lanka

189. Ms. Withanage N.S., Department of Export Agriculture, Faculty of Animal Science & Export Agriculture, Uva Wellassa University, Passara Road, Badulla, Sri Lanka

190. Dr. Yapa Y.M.A.L.W., Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

191. Dr. Yapage N., Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

192. Dr. Yatawara M.D.M.D.W.M.M.K., Department of Zoology and Envoronmental Management, University of Kelaniya, Kelaniya, Sri Lanka

- Biomedite Pvt Ltd, No. 276/2A, Hospital Rd, Kalubowila, Dehiwala.
- Bank of Ceylon, Ruhuna university branch, Matara.
- Euro4 Enterprises UK Ltd, No. 81, Oast House Close, TN37 7UY, UK.
- Hemsons International Pvt Ltd, Hemas Building, No. 36, Sir Razik Fareed mawatha, Colombo 01.
- Dell Technologies, Hilton Colombo Residence, Union Place, Colombo 02.
- Nippon Paint (Pvt) Ltd, Nilwala Place, Walgama, Matara.
- Acecam (Pvt) Ltd, No. 419-2/1 Galle Rd, Colombo.
- Freelan Enterprises Pvt Ltd, No. 38, Gunawardana Mawatha, Matara.
- Auto zone car detailing (Pvt) Ltd, Tangalle, Matara.
- Faculty of Science, University of Ruhuna.