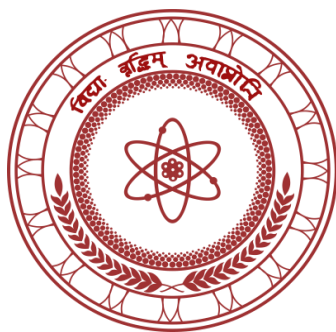# Sri Lanka Association for the Advancement of Science

Proceedings of the 78th Annual Sessions
11 – 16 December, 2022

Part I: Abstracts

Sri Lanka Association for the Advancement of Science – 2022

Proceedings of the 78th Annual Sessions

Part I – Abstracts

11 – 16 December, 2022

Sri Lanka Association for the Advancement of Science
Vidya Mandiraya,120/10 Vidya Mawatha, Colombo 07, Sri Lanka
www.slaas.lk

Edited and Compiled by: *Theshini Perera, Editor*

Sashiprabha M Vitharanarachchi, Assistant Editor

Contents

Oral Presentations

Posters

Titles of Abstracts

Oral Presentations

101/A

Urinary annexin A3 and neutrophil gelatinase-associated lipocalin: Potential diagnostic biomarkers for diabetic nephropathy

S. Saseevan[1,2], S. Rajapakse[2,3] and D.N. Magana-Arachchi[1]*

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka

Diabetic nephropathy (DN) is one of the major complications of diabetes mellitus. Tubular lesions initially characterize DN before the glomerular injury. Therefore, albuminuria is not sufficient to diagnose DN. Urinary neutrophil gelatinase-associated lipocalin (*NGAL*) excretion is elevated in response to tubular injury. Annexin A3 (*ANXA3*) gene expression is found in mesangial cells of renal glomeruli and is linked to mesangial expansion. The aim of this study is to identify potential diagnostic urinary biomarkers for DN and their correlation with existing renal markers such as serum creatinine and estimated glomerular filtration rate. RNA extracted from urine samples ($n =$ 82) including DN ($n =$ 17), hypertensive nephropathy ($n =$ 31), chronic kidney disease (CKD) with both diabetes and hypertension ($n =$ 11), other cause of CKD ($n =$ 13) and healthy controls (HC) ($n =$ 10) were reverse transcribed and used for gene expression analysis using quantitative polymerase chain reactions. Gene expression of *ANXA3* and *NGAL* genes were analyzed against the reference gene, β2-microglobulin (*B2M*), using the relative quantification method. Fold changes (FC) of gene expression in DN, hypertensive nephropathy and other CKD study groups were calculated against HC. Log 2 normalized FC was used to study the significance level and correlation with existing serum markers. *NGAL* had greater than fourfold upregulation (FC = 9.83 ‡ 5.31) in DN patients compared with HC. The FC of *NGAL* in early and late DN was 11.68 ± 7.87 and 5.15 ± 3.07, respectively. Upregulation of the *ANXA3* gene was significantly high ($p =$ 0.000), (FC = 782.91 ± 214.60) in DN compared to other chronic kidney diseases associated with hypertension and other causes. No significant correlation exists between the identified gene expression and existing serum markers ($p >$ 0.05). *NGAL* has a good prognostic value for renal tubular injury-related biomarkers than glomerular-specific markers like albuminuria to diagnose DN and assess the disease progression. However, *ANXA3* could be a better biomarker for differential diagnosis of DN relative to the aetiology of CKD. The regulation of these genes and their related molecular pathways must be studied further in a large cohort for clinal validation.

Keywords: Annexin A3, diabetic nephropathy, Neutrophil Gelatinase-Associated lipocalin

E-mail: dhammika.ma@nifs.ac.lk

102/A

Hepatoprotective potential of the different extracts of *Munronia pinnata (Wall) Theob.* against carbon tetrachloride-induced hepatotoxicity

S.D. Hapuarachchi[1]*, T.S. Suresh[2], W.T.P.S.K. Senarath[3], S.M. Hadunnetthi[4] and K. Samarasinghe[5]

[1]*Unit of Pharmacology and Pharmaceutics, Department of Ayurveda, Institute of Indigenous Medicine, University of Colombo, Sri Lanka*
[2]*Department of Biochemistry, University of Sri Jayewardenepura, Sri Lanka*
[3]*Department of Botany, University of Sri Jayewardenepura, Sri Lanka*
[4]*Institute of Biochemistry, Molecular Biology and Biotechnology, University of Colombo, Sri Lanka*
[5]*Department of Pathology, University of Sri Jayewardenepura, Sri Lanka*

In time immemorial *Munronia pinnata* Wall Theob. has been used to treat a variety of ailments in the traditional Sri Lankan medical system. In this study an attempt has been made to validate the hepatoprotective actiivity of different extracts of *Munronia pinnata* (MP) and compare it with the established Ayurveda hepatoprotective agent, *Andrographis paniculate* (AP) against carbon tetrachloride induced hepatoxicity. The aqueous and ethanol extracts of MP and the aqueous extract of AP were prepared from the shade-dried whole plants. The model of carbon tetrachloride induced hepatoxicity in healthy Wistar rats, liver histopathological observation and serum marker enzymes were analyzed to assess the hepatoprotective efficacy of MP. The results showed a significant hepatoprotective effect of the aqueous and ethanolic extracts of the MP in healthy Wistar rats against liver damage induced by CCl_4 toxicity. Levels of serum marker enzymes such as AST, ALT and ALP of the olive oil-treated group (vehicle control) were not significantly elevated when compared with that of normal healthy rats. The CCl_4 treated group showed a statistically significant ($p < 0.05$) elevation in levels of serum marker enzymes (AST, ALT and ALP) when compared with the tested groups (137.3±2.7, 138.1±0.6, and 387.1±8.2). These findings are comparable with existing reports. The extracts of *Munronia* have the ability to give protection against liver injury upon CCl_4 induction. This study provides a scientific rationale for the traditional use of this herb in the management of liver disorders. These results validated the use of both herbs (*M. pinnata* and *A. paniculata*) as a substitute for *Swertia chiraita* plant in its role as a hepatoprotective agent.

Keywords: *Munronia pinnata,* hepatoprotective activity, carbon tetrachloride

E-mail: dr.sdhapuarachchi@iim.cmb.ac.lk

103/A

Evaluation of the impact of nutritional counselling on the nutritional status of post-operative patients with coronary artery bypass graft

M.K.D.O. Warunika and A.M.N.T. Adikari*

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

Nutritional counseling is an intervention that treats nutrition imbalances that lead to malnutrition, chronic diseases, and other clinical conditions. Coronary artery bypass graft (CABG) surgery is a method used to treat cardiovascular diseases. In surgical patients, nutritional counseling supports fast recovery and reduces complications. However, studies determining the effect of nutritional counseling on CABG patients in Sri Lanka are limited. Therefore, the aim of this study was to evaluate the impact of nutritional counseling on the nutritional status of post-operative CABG patients. The study employed a pre-post design. Thirty post-operative CABG patients (Males; 20, Females; 10), age >18 years who had undergone surgery during the two-month period from October to November 2021 were recruited from a private hospital. Post-operative individual nutritional counseling was provided at the hospital by a registered dietitian. Observations on nutritional counseling, patients' information sheets available with the dietitian, and a pre-tested interviewer-administered questionnaire *via* telephone were used for data collection. At baseline, data were collected on patients' characteristics, medical information, nutritional status-related biochemical parameter information, and dietary information. At the first hospital visit after surgery, patients' length of wound healing period and biochemical parameters were obtained. The impact of nutritional counseling was determined using the improvement of biochemical parameters, dietary habits, and wound healing period of patients. Findings confirmed improved biochemical parameters from high levels to a healthy range for random blood glucose levels and serum albumin levels in 20% and 16.7% of patients, respectively. Serum albumin level of 33.3% of patients improved from a low level to a healthy range. The length of wound healing period (mean 3.07+1.2 weeks) was less than two weeks for 36.7% of patients. Vegetable consumption of 33.3% of patients increased from <2 servings to 2–4 servings per day. Majority, 86.7% of patients changed their usage of coconut milk type from first round of extraction to second round of extraction for cooking meals. The results revealed that nutritional counseling positively impacted the nutritional status of postoperative CABG patients. Further studies should be performed on nutritional counseling for CABG patients in both government and private hospitals to determine the impact of nutritional counseling on other surgical procedures.

Keywords: Coronary artery bypass graft surgery, nutritional counseling, nutritional status

E-mail: namalithakshila@wyb.ac.lk

104/A

Investigation of disease presentation in primary and secondary infection of dengue in three clinical settings from 2016-2019

J.A.J.C. Jayarathne, G.K.D.L. Perera, Thusitha P. Muhandiramlage, K.A.D.C. Gunasekara and C.W. Subasinghe*

Department of Biochemistry and Clinical Chemistry, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka

Dengue is a mosquito-borne viral disease. Antigenically and genetically differentiable single stranded positive sense RNA viruses classified as serotypes (DENV1, DENV2, DENV3 and DENV4) cause the infection. Dengue infected patients display a spectrum of clinical presentations including afebrile, undifferentiated fever, dengue fever (DF), dengue hemorrhagic fever (DHF), dengue shock syndrome (DSS) and expanded dengue syndrome. Studies enunciated that the hypothesis of antibody dependent enhancement plays a major role in disease severity. The objective of this study was to investigate the association between the prior exposure of dengue infection and disease severity and serotype presentation in subsequent infections for early differentiation. A laboratory based-descriptive study was carried out from 2016 to 2021 in North Colombo Teaching Hospital, Base Hospital Kiribathgoda and District Hospital Maligawatte. Accordingly, 689 febrile patients were recruited and serum samples were collected. Subsequently, they were subjected to NS-1 antigen test and DENV PCR. Of all samples, 129 were positive for NS-1 antigen while 90 out of 129 were positive for PCR in which DENV2 was predominant every year with percentages varying from 50–100% (n = 72). DENV1 was present only in 2016 and 2019 with 14.2% (n = 3) and 15.38% (n = 4), respecteively. In clinical presentation, 84% of DF (n = 42) and 16% (n = 8) of DHF were primary dengue infections while 73.5% of DF (n = 25) and 26.5% of DHF (n=9) were secondary dengue infections. Prevalence of secondary dengue infection was 40.47%. In conclusion, there was no association between the disease severity with either primary or secondary infection (P = 7.76; P>0.05). There was no association between disease severity and serotype presentation (P = 1.375; P>0.05). Although secondary infections are believed to be more frequently associated with the severe form of disease, majority with severe disease had primary dengue infection.

Keywords: Dengue, serotypes, severity, primary, secondary

E-mail: cwsubasinghe@kln.ac.lk

105/A

Validity of the malnutrition screening tool for surgical patients

W.W.L.A.H. Wanigasinghe and A.M.N.T. Adikari*

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

The malnutrition screening tool (MST) is a tool to screen patients. Malnutrition is a prevalent condition that is assessed by using nutritional screening tools. The malnutrition screening tool has not been validated for surgical care settings. Hence, this study was designed to validate the MST for surgical patients. A cross-sectional study was conducted to assess the risk of malnutrition and nutritional status of hospitalized surgical patients at a private hospital in Colombo. Adults who were above 18 years of age and had the ability to communicate were recruited for the study. Height and weight measurements, and nutrition-related biochemical and medical information were collected using the assessment forms of the dietitian. Dietary information was collected by telephone interviews using a pretested interviewer-administered questionnaire. The selected hospital uses MST as its screening tool for patients upon admission to the hospital. The MST was compared with the malnutrition universal screening tool (MUST), a validated screening tool to identify adults who are malnourished or at risk of malnutrition in hospitals, communities, and other care settings. The mean age of hundred surgical patients was 56.84 ± 1.4 years. According to MUST, 73% of patients were at low risk, 18% were at moderate risk and 9% were at high risk of malnutrition. According to MST, 20% of patients were at risk and 80% were not at risk of malnutrition. The MST had a low sensitivity of 48.15% (95% confidence interval [CI] 46% to 34%) and a specificity of 90.41% (CI 81.24%–96.06%). The positive predictive value was 65% (CI 45.34%–80.61%) and the negative predictive value was 82.5% (CI 76.49%–87.23%). The agreement was moderate as represented by the Kappa Coefficient of 0.420. Although the MST is simple, quick, and easy to use, according to the finding of the study, it is not a suitable screening tool for detecting the risk of malnutrition in hospitalized surgical patients. The absence of an acceptable sensitivity for the screening components of the MST for surgical patients, suggests that further prospective research using the MST is required to confirm its validity as a screening tool in hospitalized surgical settings in Sri Lanka.

106/A

Blood meal preferences of *Aedes aegypti* (Linnaeus) and *Ae. albopictus* (Skuse) in the district of Colombo

E.H.L. Perera[1], M.D. Hapugoda[1], T. Ranathunge[2], L. Udayanga[3] and Y.I.N.S. Gunawardene[1]*

[1]Molecular Medicine Unit, Faculty of Medicine, University of Kelaniya, Sri Lanka
[2]Department of Zoology, Faculty of Science, Eastern University, Sri Lanka
[3]Department of Biosystems Engineering, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka

Dengue is an arboviral infection transmitted by infected *Ades* female mosquitoes, namely *Aedes aegypti* (Linnaeus) and *Ae. albopictus* (Skuse). Limited knowledge on behavioural patterns of *Aedes* species has become a major limitation in vector control programmes in Sri Lanka. Hence, the current study was conducted to determine the key bionomic aspects on feeding preferences of *Ae. aegypti* and *Ae. Albopictus* in the district of Colombo. Three dengue high-risk medical officer of health (MOH) areas in the Colombo district, representing rural, urban and semi-urban settings, namely Padukka, Kolonnawa and Maharagama, were selected as study areas. Adult mosquito surveillance was conducted at 25 randomly selected households in each study site-covering a radius of 600 m from November, 2019 to October, 2020. Collected adult mosquitoes were identified using standard morphological keys. Engorged *Aedes* females were processed for DNA extraction followed by two multiplex real time PCR assays using a two-panel set of primers for the host range of bovine, human, dog, cat, chicken, rat, pig and monkey. The analysis of similarities (ANOSIM) and distance-based redundancy analysis (dbRDA) were used for statistical analysis. Overall, 112 freshly engorged female mosquitoes of *Ae. aegypti* (n = 82) and *Ae. albopictus* (n = 30) were analysed. Females of *Ae. aegypti* reported the highest reference (86.6%) for human (*Homo sapiens*) blood, followed by dogs (*Canis lupus*; 7.3%) and cats (*Felis catus*; 6.1%). In case of *Ae. Albopictus* also, human blood (60.0%) accounted for the highest preference. According to the dbRDA analysis, human blood formed one sub-cluster based on the higher preference by both *Aedes* species, while cats and dogs formed another sub-cluster. Interestingly, bovine blood formed a single cluster, which was only preferred by *Ae. albopictus*. The significance of sub-clustering status was confirmed by ANOSIM with a Global R value of 0.92 (P<0.05). This study has shown that the most preferrable host for the blood meals of *Aedes* species is human blood, while dog, cat and bovine contributed less as a host in the Colombo district of Sri Lanka.

Keywords: *Aedes*, dengue, host, blood meal, Sri Lanka

E-mail: nilminisg@kln.ac.lk

201/B

Effects of maturity stages on distribution of bioactive compounds and antioxidant activity in different parts of *Punica granatum* (L.) fruits in four different varieties

P.S.I.U. Jayarathne[1], D.C. Abeysinghe[1]*, R.M. Dharmadasa[2] and S.B.A. Weerawarna[3]

[1]*Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka*
[2]*Industrial Technology Institute, 363, Bauddhaloka Mawatha, Colombo 07, Sri Lanka*
[3]*Agriculture Research Station, Kalpitiya, Sri Lanka*

Pomegranate (*Punica granatum* L.) belongs to the family Punicaceae and has been used for its excellent culinary and medicinal values. Maturity stages and different parts of the fruit are the key factors that cause variations in bioactive compounds and antioxidant capacity of the fruit. Therefore, this study was aimed to determine the distribution of phenolics, flavonoid profile and antioxidant capacity of aril, peel, and whole fruit of pomegranate for four local varieties— *Nayana*, *Nimali*, *Daya* and *Kalpitiya* Hybrid—at four different maturity stages; one month (immature), two months (half mature), three months (mature) and four months (ripen) after fruit set. Homogenous representative fruit samples were collected from randomly selected three trees of each variety at different maturity stages. The total antioxidant capacity (TAC), total phenolic content (TPC) and total flavonoid content (TFC) were determined using ferric reducing antioxidant power (FRAP) assay, modified Folin-Ciocalteu method and aluminum chloride colorimetric method, respectively. According to the results of aril of *P. granatum* at different maturity stages, the two-month maturity stage of aril of *Nimali* variety had the highest TAC (11.53 ± 0.14 mg trolox equivalents/g of fresh weight), TPC (3.65 ± 0.42 mg gallic acid equivalents/g of fresh weight) and TFC (1.54 ± 0.10 mg rutin equivalents/g of fresh weight). Furthermore, with respect to the peel, the highest TAC (1092.25 ± 36.01 mg trolox equivalents /g of dry weight), TPC (217.26 ± 0.96 mg gallic acid equivalents/g of dry weight), and TFC (148.91 ± 2.68 rutin equivalents/g of dry weight) were observed at two-month maturity stage of *Nimali* variety. Moreover, the highest TAC (684.23 ± 65.77 mg trolox equivalents/g of dry weight), TPC (156.53± 1.25 mg gallic acid equivalents/g of dry weight), and TFC (111.80 ± 3.06 mg rutin equivalents/g of dry weight) were recorded in the whole fruit of *Nimali* variety at the immature stage (one month). In conclusion, the TAC, TPC and TFC were higher during early maturity stages of *P. granatum* and declined with the fruit development. Hence, immature fruits and fruit parts could be incorporated into the production of value-added nutraceuticals.

Keywords: Aril and peel of fruits, antioxidant capacity, bioactive compounds, maturity stages, *Punica granatum*

E-mail: abeysinghedc@yahoo.com

202/B

Bioactive compounds and antioxidant capacity of tender shoots of five tea (*Camellia sinensis* L.) cultivars grown in three different elevations in Sri Lanka

S.A. Wickremeratne[1], M.M. Nipunika[1], R.A.A.P. Marapana[1], D.V.S. Abeysinghe[2] and D.C. Abeysinghe[1]*

[1]*Department of Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka*
[2]*Department of Food Science and Technology, University of Peradeniya, Peradeniya, Sri Lanka*

Camellia sinensis belongs to the family Theaceae, and it has numerous health benefits due to its bioactive compounds and antioxidant capacity. In Sri Lanka, different tea cultivars are grown in all three major elevations (up, mid and low country). However, information is lacking about bioactive compounds and antioxidant capacity of different local tea cultivars based on their growing elevations. Therefore, this study was undertaken to determine bioactive compounds and antioxidant capacity of five selected tea cultivars (TRI 2023, 2043, 3072, 4006 and 4052) grown in three different elevations in Sri Lanka. Tender tea shoots of the selected cultivars from all three elevations were collected based on completely randomized design, and the samples were tested for total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) using Folin-Ciocalteu method, colorimetric method, and ferric reducing antioxidant power (FRAP) assay, respectively. Among the selected up-country cultivars, the highest TPC, TFC and TAC were recorded in TRI 3072 (65.44 ± 3.15 mg gallic acid equivalents (GAE)/g dry weight (DW), 86.47 ± 5.36 mg rutin equivalents (RE)/g DW, 74.96 ± 2.74 mg trolox equivalents (TE)/g DW) and the TPC and TAC of TRI 3072 were not significantly different from those of TRI 4052 (68.94 ± 3.71 mg GAE/g DW, 65.86 ± 1.97 mg RE/g DW, 81.82 ± 4.79 mg TE/g DW). For the mid country, the highest TPC, TFC and TAC were recorded in TRI 2043 (53.5 ± 3.44 mg GAE/g DW, 77.13 ± 2.0 mg RE/g DW, 77.51 ± 1.78 mg TE/g DW), whereas out of all the low grown cultivars, TRI 2023 recorded the highest TPC, TFC, and TAC (104.78 ± 2.58 mg GAE/g DW, 107.63 ± 1.09 mg RE/g DW, 125.85 ± 2.95 mg TE/g DW). Moreover, there was a strong positive correlation of TAC with TPC (R^2 = 0.9481, $p<0.05$) and TFC (R^2 = 0.8767, $p<0.05$) revealing the significant contribution by two of the components for the antioxidant capacity. Finally, based on bioactive compounds and antioxidant capacity, it is much favorable to use TRI 3072 and 4052 for up country, and TRI 2043 and 2023 for mid and low country tea, respectively.

Keywords: Antioxidant capacity, bioactive compounds, *Camellia sinensis*, elevations

E-mail: abeysinghedc@yahoo.com

203/B

Evaluation of total phenolic, flavonoid contents and antioxidant capacity of three main tea (*Camellia sinensis*) grades manufactured in seven regions of Sri Lanka

P.C.J. Panagoda[1], R.A.A.P. Marapana[1], M.M. Nipunika[1], D.V.S. Abeysinghe[2] and D.C. Abeysinghe[1]*

[1]*Department of Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka*
[2]*Department of Food Science and Technology, University of Peradeniya, Peradeniya, Sri Lanka*

Sri Lankan tea is popular as "Ceylon Tea" around the world. There are seven major tea growing regions (Nuwara Eliya, Udupussellawa, Uva, Dimbula, Kandy, Sabaragamuwa and Ruhuna) in Sri Lanka and tea from each region has unique characteristics due to variations in soil and climatic conditions in each agro-ecological region. However, there is a dearth of studies about tea grades in these seven regions. Hence, this study was undertaken to determine the total phenolic content (TPC), total flavonoid content (TFC) and the total antioxidant capacity (TAC) of Broken Orange Pekoe (BOP), Broken Orange Pekoe Fannins (BOPF) and Dust No 1 grades manufactured in the seven regions in Sri Lanka. The TPC, TFC and TAC in methanolic extracts of three main tea grades from the seven regions were determined by using Folin-Ciocalteu method, aluminium chloride method and ferric ion reducing antioxidant power (FRAP) assay, respectively. Among all the tested tea grades in all seven regions, the highest TPC (91.07±4.79 mg gallic acid equivalents (GAE)/ g dry weight (DW), TFC (42.24 ± 2.98 mg rutin equivalents (RE)/ g DW) and TAC (133.91 ± 6.55 mg trolox equivalents (TE)/ g DW) were recorded in Dust No 1 grade in Ruhuna region, whereas the lowest TPC (50.41 ± 1.83 mg GAE/ g DW), TFC (84.47 ± 0.73 mg RE/ g DW) and TAC (72.57 ± 14.29 mg TE/ g DW) were recorded in BOP grade in Kandy region. Order of increase of TPC, TFC and TAC in three main tea grades in all seven regions can be observed as Dust No 1 > BOPF > BOP. Therefore, out of all the tea samples tested, low grown Dust No 1 grade had significantly higher total polyphenol content (TPC), total flavonoid content (TFC) and total antioxidant activity (TAC).

Keywords: Antioxidant capacity, *Camellia sinensis,* flavonoid content, phenolic content, tea grades

E-mail: abeysinghedc@yahoo.com

204/B

Effect of different processing methods and types of rhizomes of *Curcuma longa* collected from different agro-ecological regions on content of bioactive compounds and antioxidant capacity

M.S.C.J. De Silva[1], D.C. Abeysinghe[1]* and R.M. Dharmadasa[2]

[1]*Department of Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka*
[2]*Industrial Technology Institute, 363, Bauddhaloka Mawatha, Colombo 07, Sri Lanka*

Curcuma longa L., turmeric, is a therapeutically important medicinal plant and a common spice belonging to the family Zingirberaceae. Turmeric powder was made using turmeric rhizome, and locally there are various processing methods. However, none of the methods has been identified yet, as being healthy. The present study was conducted to determine the effect of different processing methods (steaming method, boiling method and raw method without steaming or boiling) and different types of rhizome (finger rhizome and mother rhizome) on bioactive compounds and antioxidant capacity of *C. longa* collected from different agro-ecological zones. Total antioxidant capacity (TAC), total phenolic content (TPC) and total flavonoid content (TFC) were determined using ferric reducing antioxidant power (FRAP) assay, modified Folin-Ciocalteu method and colorimetric method, respectively. Samples were collected randomly from four different agro-ecological zones (Nikawaratiya, Kandy, Galle and Divulapitiya), and the analysis was done by complete randomized design (CRD) with three replications. The results revealed that all studied processing methods and rhizome parts resulted marked amounts of TAC, TPC and TFC in *C. longa*, but neither processing method nor plant part made any significant changes in studied bioactive compounds. The highest TPC and TFC values were recorded in mother rhizome steaming method collected from Nikawaratiya (IL3)(13.26 ± 0.1 mg gallic acid equivalents/g dry weight, 20.08 ± 2.02 mg rutin equivalents/g dry weight) and the highest TAC value was recorded in mother rhizome raw method collected from Nikawaratiya (IL3)(46.8 ± 2.86 mg trolox equivalents/g dry weight). Among all the processing methods and the plant parts, the lowest value of TPC was recorded in mother rhizome boiling method collected from Divulapitiya (WL3) (9.24 ± 0.071 mg gallic acid equivalents/g dry weight), while the lowest TFC was recorded in mother rhizome raw method collected from Kandy (WM3) (15.3 ± 1.2 mg rutin equivalents/g dry weight) and the lowest TAC was recorded in mother rhizome boiling method collected from Kandy (WM3) (34.21 ± 1.94 mg trolox equivalents/g dry weight). According to the results, none of the processing methods explored here has made a significant change in the tested bioactive compounds and antioxidant capacity of *C. longa* collected from different agro-ecological zones. Similarly, the two different rhizome parts have no significant difference in the studied compounds.

Keywords: Agro-ecological zone, antioxidant capacity, bioactive compounds, *Curcuma longa*

E-Mail: abeysinghedc@yahoo.com

205/B

Screening of bee honey collected from different regions in Sri Lanka for phenolic content, antioxidant capacity and physicochemical properties

A.S.I. Rajapaksha[1], D.C. Abeysinghe[1]* and R.M. Dharmadasa[2]

[1]Department of Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka
[2]Industrial Technology Institute, Bauddhaloka Mawatha, Colombo 07, Sri Lanka

As a result of the COVID 19 pandemic, bee honey has recently gained appeal in society due to its health benefits, particularly its antiviral and immunity-boosting properties. The phenolic compounds are responsible for the antioxidant, antimicrobial, and anti-inflammatory properties of bee honey, and the phenolic compositions in bee honey depend on many factors. However, local information on antioxidant activity, bioactive compounds and physicochemical properties present in bee honey collected from different regions in Sri Lanka are lacking. Therefore, the study was conducted to evaluate the phenolic content, antioxidant capacity and physicochemical properties of bee honey samples collected from eight different regions in Sri Lanka. A completely randomized design with three replicates of all samples was used in the experiment. Ferric reducing antioxidant power (FRAP) assay and Folin-Ciocalteu method were used to determine total antioxidant capacity (TAC) and total phenolic content (TPC), respectively. Mean values obtained for TPC ranged between 180.92 and 779.22 mg gallic acid equivalents/kg and mean values obtained for TAC ranged between 59.52 and 255.07 mg trolox equivalents/kg. Furthermore, the results revealed that the moisture content ranged from 8.40 to 22.66% (w/w), the electrical conductivity ranged from 0.20 to 0.88 mS cm^{-1}, the ash content ranged in between 0.12 and 0.42%, the pH ranged from 3.72 to 4.94, the soluble solids ranged from 58.13 to 79.73 °Bx and the viscosity ranged from 0.47 to 3.11 Pas. The results of this study reveal that the studied bioactive compounds in bee honey have considerable variations across different regions of the country. This variation could be due to both the honey's floral source and its geographic location. According to this study, bee honey collected from the places with a range of plant species has a significant level of antioxidant activity, making it appropriate for a variety of medicinal applications and the development of pharmaceutical products incorporating bee honey. Further, the information gathered in this study could be incorporated for quality control and standardization of bee honey.

Keywords: Bee honey, phenolic content, physicochemical properties, total antioxidant

E-mail: abeysinghedc@yahoo.com

206/B

Effect of fermentation temperature and time on bioactive compounds in low country black tea

R.A.U.J. Marapana* and K.V.K.N. Senadheera

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Fermentation temperature and time act as the major determinants of black tea quality. Bioactive compounds are extra nutritional components in foods in trace amounts. This study aimed to identify the changes of bioactive compounds; namely, polyphenols, flavonoids, and antioxidants in low country tea produced under different fermentation temperatures and durations. Withered and rolled tea leaves were fermented at different temperature ranges (15–20, 25–30 and 35–40 °C) for different durations (1–2, 2–3 and 3–4 hours) and then dried at 85 °C for 30 minutes. The extracts of tea samples were analyzed for total polyphenol content (TPC), total flavonoid content (TFC) and antioxidant content. TPC, TFC and antioxidant content were determined by Folin-Ciocalteu, aluminum chloride and ABTS assay methods, respectively. The data were analyzed using two factor three level factorial design by MINITAB 19. Statistical analysis revealed that fermentation temperature has a significant effect on the TPC, antioxidant content and TFC ($P < 0.05$), while fermentation time has a significant effect ($P < 0.05$) only on the TPC and TFC but not on the antioxidant content ($P > 0.05$). There was a significant interaction effect of fermentation temperature and time ($P < 0.05$) on the TPC, antioxidant content and TFC. TPC of tea samples were in between 23.72 and 76.50 mg GAE/100 ml. Antioxidant content and TFC ranged between 2.18–3.54 mg AAE/ml and 1.77–3.61 mg QE/ml, respectively. Tea sample fermented at 15–20 °C for 1–2 hours showed the highest TPC and antioxidant content while the highest TFC was obtained from the sample fermented at 35–40 °C for 2–3 hours. The Lowest TPC and antioxidant contents were observed from the sample fermented at 35–40 °C for 3–4 hours. The samples fermented at 15–20 °C for 2–3 hours showed the lowest TFC. The increment of fermentation temperature decreased the TPC and antioxidants, whereas it increased the TFC. Increment of fermentation time resulted a decrease in TPC. Further research needs to be carried out for mid and up-country tea.

Keywords: Antioxidants, fermentation temperature, fermentation time, flavonoids, polyphenols

E-mail: umarapana@sci.sjp.ac.lk

207/B

Minimizing the actual and the potential yield gap of cashew (*Anacardium occidentale* L): quantifying the organic fertilizer requirement

K.C. Guruge and H.M.I.K. Herath*

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

Cashew (*Anacardium occidentale* L) is an important cash crop in Sri Lanka. There is an unmatched gap between the actual (4–5 kg/tree/year) and the potential yields (15 kg/tree/year) set by the Cashew Corporation of Sri Lanka (CCSL). One of the main causes for low yield is the insufficient nutrient supply. This study aimed to quantify the nutrient requirement of cashew plantations considering nutrients inflows and outflows and to minimize the yield gap by using organic and conventional fertilizers. Nutrient budget was calculated based on nutrient inflows, which include fertilizer application and soil nutrient pool. As the nutrient outflows, nutrient consumption by tree, removal by yield as cashew nut, and other losses were considered. Ten years (2010–2020) yield records were obtained from plantations of CCSL. The off-take nutrients were quantified by laboratory analysis of harvested nuts. The nutrient requirements for different growth stages of trees were assessed based on published data. The nutrient budget was calculated and conventional fertilizer requirement was quantified under two scenarios. The first scenario assumed no loss of nutrients from the system. The second scenario assumed that the loss of nutrients is equal to the nutrients supplied through the soil. In both scenarios' nutrients from leaf litter, flowers and cashew apples were considered as recycled based on current practices. The harvested nuts contained 1.97% of Nitrogen (N), 0.24% of Phosphorus (P), and 0.68% of Potassium (K). The plant dry weight increment in terms of N, P and K were 3000, 494 and 1776 g/tree/year, respectively. Soil analysis showed that soil nutrient content was very low as 0.19% of N, 5.21 ppm of P and 4.60 ppm of K. These data were used to assess the organic and conventional fertilizer requirement for *Anacardium occidentale* L. by calculating the nutrient budget. As the required conventional fertilizer for expected yield in the first scenario, could be supplied either cattle manure - 233.7 kg/tree/year or broiler litter - 101.0 kg/tree/year or layer litter - 143.8 or compost - 340.0 kg/tree/year. Fertilizer requirement for the second scenario could be either cattle manure - 234.2 kg/tree/year or broiler litter - 149.5 kg/tree/year or layer litter - 153.1 kg/tree/year or compost - 340.6kg/tree/year. This application could help to minimize the unmatched gap in cashew between the potential and actual yields.

Keywords: Cashew, fertilizer requirement, nutrient budgeting, organic and conventional fertilizer, yield gap

E-mail: kcguruge123@gmail.com

208/B

Utilization of Sri Lankan rice varieties in developing a value-added rice milk product

P. De A. Abeysundara* and P.D.S.A. Goonathilaka

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The world is shifting towards non-dairy consumption through plant-based dairy alternatives. Among many such alternatives, rice (*Oryza sativa,* L.) milk from the category of cereal-based milk products is gaining recognition among consumers. This study was carried out to evaluate the potential of traditional rice variety Suwandel in developing a value-added rice milk product by incorporating locally available spices; namely, clove (*Syzygium aromaticum*), ginger (*Zingiber officinale*) and garlic (*Allium sativum*). Eight beverage formulations were prepared according to Taguchi L8 orthogonal array method. According to the sensory characteristics of formulations, the formula with the highest overall acceptability, the unpolished Suwandel rice milk base with 2.5% (w/v) clove, 10% (w/v) ginger, and 20% (w/v) garlic was selected as the best formulation. The moisture, carbohydrate, ash, total fat, crude protein, and crude fiber contents of the product were $87.12 \pm 0.47\%$, $34.82 \pm 0.15\%$, $0.36 \pm 0.00\%$, $2.93 \pm 0.04\%$, $1.83 \pm 0.16\%$ and $32.28 \pm 0.99\%$, respectively. Moreover, the developed rice milk product showed a high antioxidant potential with reference to total phenolic content (TPC) (5.335 ± 0.389 mg GAE/100 g), and percentage inhibition of DPPH ($62.00 \pm 0.85\%$) and ABTS ($63.83 \pm 3.40\%$) assays with significant differences to the control sample without plant extracts (p value< 0.05, TPC 2.335 ± 0.341 mg GAE/100 g, DPPH $40.60 \pm 0.73\%$ and ABTS $21.99 \pm 2.85\%$). GC-MS analysis for volatile compounds in the beverage confirmed the incorporation of plant extracts with high intensities related to their components. The calcium, lead and arsenic contents of the beverage were 0.21 μg/100 g, 0.94 μg/100 g, and 5.71 μg/100 g, respectively and were in accordance with SLSI standards. The developed value-added rice milk product showed a good nutritional composition with high consumer acceptability. Consumption of this valued added rice milk offers multiple benefits and could be used for the development of a commercial rice milk beverage after conducting an appropriate scale-up and pilot plant study.

Keywords: Compositional analysis, functional beverages, rice milk, suwandel rice

E-mail: piumi@sci.sjp.ac.lk

209/B

Screening of pollens grains in bee honey based on floral sources and its geographic locations in Sri Lanka

S.D.T. Mahawela[1], D.C. Abeysinghe[1]* and R.M. Dharmadasa[2]

[1]*Department of Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka*
[2]*Industrial Technology Institute, BauddhalokaMawatha, Colombo 07, Sri Lanka*

In the honey market, botanical and geographical miss-labeling has become a critical problem worldwide. The objective of this study was to investigate a reliable technique to authenticate the botanical origin of seven kinds of Sri Lankan honey collected from different regions of Sri Lanka. Bee honey samples were collected from different regions of Sri Lanka and from open market as the control. The methodology recommended by the International Commission of Bee Botany was followed. Results revealed that two honey samples were uni-floral while the remaining six samples were multi-floral. The highest frequency of pollen was reported from family Euphorbiaceae. With regards to the frequency of occurrence of pollen types in honey samples, family Euphorbiaceae, Fabaceae, and Verbenaceae plant pollen types were found to be frequent as they were recovered from more than 45% of the honey samples. The absolute pollen content per gram of honey was in the range of 17,000–1,345,000. Minimum pollen count (17,000) was found in the open market sample and the highest number of pollen density (>1,000,000/10 g) recorded in Mahiyanganaya and Wariyapola honey samples. This could be categorized into low quality and high quality honey with low and high pollen concentrations, respectively. The information generated in the present study will be a useful tool for the accurate identification of bee honey collected from different regions of Sri Lanka. Through identifying the major nectar plant sources for honeybees, this study demonstrated the potential for expanding and sustainable bee keeping practices in Sri Lanka.

Keywords: Morphology, multifloral honey, pollen analysis, uni-floral honey

E-mail: abeysinghedc@yahoo.com

210/B

Quantification of nitrate and ammonium leaching from chili (*Capsicum annuum* L.) cultivation under growers' fertilization package in Kalpitiya area

D.S.G.G.C. Swarnathilake and H.M.I.K. Herath*

Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka

The overuse of inputs in intensive cultivation have caused many environmental and health problems in the Kalpitiya area. This study aimed to quantify the nitrate and ammonium leaching from chili cultivation under grower-managed fertilizer practices compared to the Department of Agriculture (DOA) recommendation. The experiment was arranged in Completely Randomized Block Design with three replicates in six plots (7.2 m^2). The MICH1 variety was established in the field where lysimeters were previously installed. Growers' rate of fertilizer application (T1) and DOA recommendation (T2) applied as treatments. The T1 was split applications of TSP at 100 kg/ha, hydro fertilizer (12:11:18) at 37 kg/ha, liquid fertilizer (24:24:18) at 2.5 L/ha at weekly intervals. Mixed fertilizer (30:10:10) at 62 kg/ha and blue granules (12:12:17) at 123.5 kg/ha were applied every other week at the flowering stage until harvesting. For T2 urea, TSP and MOP were applied as recommended. Irrigation was done twice a day and leachate was collected weekly and analyzed. The Kjeldhal method was used for determining the total nitrogen content in soil. The chili harvest was recorded, and data were statistically analyzed. The total Nitrogen of initial soil was very low (0.04%±0.03). The cumulative leached nitrate throughout the season from T1 and T2 were 948.84 kg/ha and 914.77 kg/ha, respectively, and it was not significantly differed (P<0.05). The cumulative ammonium leaching in T1 and T2 were 24.8 kg/ha and 26.5 kg/ha. The concentration of nitrate in leachate ranged from 22 mg/L–180 mg/L in T1 and 13.2 mg/L–158 mg/L in T2. Moreover, the concentration of ammonium ranged from 0.4 mg/L–4.27 mg/L in T1 and 0.63 mg/L–4.1 mg/L in T2. Both treatments showed higher levels than WHO permissible level of nitrate (50 mg/L) and lower levels than WHO permissible level of ammonium (35 mg/L) for drinking water. Chili yield from T1 and T2 were 4312.5 kg/ha and 2835.65 kg/ha, respectively and they were significantly differed. The farmers who followed split application were able to get higher yield than T2. The total nitrogen leaching percentage of T2 (66%) was lower than T1 (89%) even though the crop yield of T2 was lower. However, both systems showed leached nitrate concentrations above the safe limits recommended by WHO, which urges the need for change in nitrogen fertilizer management for chili crop on sandy Regosols.

Keywords: Groundwater contamination, nitrate leaching, sandy regosol

E-mail: gaya.swarnathilake@gmail.com

211/B

Development of a biodegradable packaging with antimicrobial properties from cassava starch by incorporating *Ocimum tenuiflorum* (Heen Maduruthala) extract

I.A.D.S.R. Gunathilake and M.A.D. Somendrika*

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Due to its outstanding qualities, plastic is proven to be the best petroleum-derived packaging material in recent times, but it takes a long time to degrade and accumulates over time, which causes serious environmental issues. Cassava starch-based biodegradable antimicrobial packaging films can be a substitute for conventional synthetic packaging as a sustainable solution for this problem. The objectives of this study are to develop the film and analyze the physical, chemical, antimicrobial properties of the packaging material. This study used the mostly grown local cassava variety MU51, and the extracted starch yield was 18.78±0.11%. Films were prepared by casting technique using cassava starch (6 g/100 g solution) and glycerol (25 g/100 g starch). Different concentrations of *Ocimum tenuiflorum* organic extract was incorporated as 1 g, 2 g, and 3 g per 100 g solution to the developed films. Tensile strength (TS), elongation at break (EB), young modulus (YM), thickness, colour, transmittance, water solubility, moisture content, water vapor transmission rate (WVTR), antimicrobial effect, biodegradability, thermal stability, cyanide content, compound analysis and tendency of leakages were evaluated in those films compared to a control sample. When the plant extract was added, the moisture content, thickness, water solubility and WVTR were increased, while EB and transmittance was decreased significantly ($p<0.05$) compared to the control sample. TS and YM did not show any significant difference among samples. The addition of *O. tenuiflorum* extract improved the antimicrobial effect of cassava starch films and remarkably inhibited the microbial growth in apple samples. According to the GC-MS analysis, the main responsible compounds for the antimicrobial effect were determined as Eucalyptol and Caryophyllene. There were no compounds that transferred to the food sample from the packaging film, which ensured that there would be no leakages. The developed films showed high biodegradability, good thermal stability, which was approximately 300 °C and negligible cyanide content as 1.74 ± 0.06 ppm. Characteristic volatile compounds of green apple were highly presented in the sample covered by the developed film (82.06%) compared to the control sample (3.69%). *Ocimum tenuiflorum* incorporated cassava starch films have a great potential as a novel active food packaging.

Keywords: Active packaging films, antimicrobial films, cassava starch biodegradable packaging, *Ocimum tenuiflorum* extract

E-mail: dsomendrika@sci.sjp.sc.lk.com

212/B

Formulation of a curry powder enriched with bioactive compounds and micronutrients

Jayada Gallege and M.A.J. Wansapala*

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Curry powder is a popular flavor enhancer and it has a good potential to enrich with bioactive compounds and micronutrients due to its regular consumption in constant amounts. Incorporation of certain well-known raw materials into the curry powder may help to increase the amount of bioactive compounds that positively react to enhance the functional properties of the product. The aim of the study was to develop bioactive compounds and micronutrients enriched curry powder and compare the proximate composition, physicochemical properties, mineral profile, and fatty acid profile of the new product and the control sample. For enrichment process, dried powders of *Sesbania grandiflora* flower, *Sargassum polycystum, Musa sp.* pseudo stem*, Pleurotus ostreatus, and Nigella sativa* seeds were incorporated into the control curry powder mixture and formulated the new curry powder mixture. The composition of control curry powder is coriander seeds (56.27%), fennel seeds (13%), cumin seeds (24%), cinnamon (0.03%), curry leaves (0.4%), garlic (0.7%), fried mung beans (1.3%), fried white rice (1.3%), pepper (2%), fenugreek seeds (1%). The composition of newly developed curry powder was determined conducting sensory evaluation sessions according to the Taguchi's L8 design. Control and value-added curry powders were analyzed for their proximate composition (moisture, protein, fat, carbohydrate, ash and crude fiber), antioxidant activity (DPPH and ABTS radical scavenging activity), total phenolic content (TPC), fatty acid profile, and mineral profile following the standard procedures of AOAC. Moisture, crude fiber, protein, ash, total phenolic contents and anti-oxidant capacity were significantly ($p < 0.05$) increased in the new product. Carbohydrates and total fat contents were significantly decreased in the new product. Ca, K, Na, Zn, Cu, Pb, and As contents were significantly ($p < 0.05$) increased in the new product than in the control. New product contained 17.19% of polyunsaturated fatty acids and 64.15% of monounsaturated fatty acids. Linoleic acid, palmitoleic acid, 1-octadiene-3-ol, 3,7-dimethyl esters were increased while oleic acid content was decreased in new product than in comparison with that of the control. Furthermore, c*is*-11,14-eicosadienoic acid methyl ester polyunsaturated fatty acids and beta-sitosterol appeared in the new product as new compounds, which were absent previously. In conclusion, adding dried powders of the above mentioned plant materials to curry powder has enhanced its functional properties.

Keywords: Bioactive compounds, curry powder, micronutrients

E-mail: jayadagallege@gmail.com

213/B

Enhancement of protein content and physiochemical properties of crackers by incorporation of *Gracilaria verrucosa* (Red algae) harvested from Trincomalee, Sri Lanka

R.M.J.N. Samarathunga[1], I. Wijesekara[2]* and M.A. Jayasinghe[2]

[1]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Department of Food Science & Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Protein requirement plays an immense role in the human diet. Therefore, enhancement of protein in food is globally essential. In this study, crackers were produced by incorporating dried and powdered *Gracilaria verrucosa*, at 0% (control), 1%, 3% and 5% (w/w) to enhance nutritional and physiochemical properties of crackers. The maximum incorporation level (5% w/w) exhibited the highest sensory attributes compared to the control (P-value < 0.05). High crude protein content (16.77±0.20% dry weight basis), low total fat content (0.18±0.00% dry weight basis) and bioactive properties including antioxidant activity (4.07%), high total phenolic content (2046.70±125 mg gallic acid equivalents/100 g dried samples) and red colour (Chromameter; L=55.37±0.32, a=5.50±0.36, b=3.87±0.40, c=6.73±0.21 and h=35.07±4.03) of *Gracilaria* powder were the impressive factors that suggested this raw material as a food ingredient. Antioxidant activity was 3 times greater and total phenolic content was higher by 5% for *Gracilaria* crackers in comparison with the control. Hardness, chewiness, gumminess, springiness, adhesiveness and cohesiveness of crackers were evaluated using the texture analyzer and hardness was increased with the addition of *Gracilaria* dried powder due to high fibre and protein contents. Interestingly, crude protein content was increased after addition of seaweed powder (Control, 1%, 3% and 5%; 15.25±0.01%, 18.63±0.28%, 20.33±0.01% and 25.01±0.01% dry basis, respectively). The shelf-life was evaluated through microbiological tests and was kept for 15 days (at 30 °C, aerobic plate count < 2x105 cfu/g and yeast and mold count < 1x105 cfu/g). The functional properties of dried seaweed powder and crackers were analyzed as a preliminary step in bakery product to improve their quality. Water holding capacity (WHC) and oil holding capacity (OHC) of crackers incorporated with *G. verrucosa* were significantly different (P-value<0.05) and values were higher than the control (WHC ranges from 4.70±0.15 to 6.16±0.05 g H_2O/g sample and OHC ranges from 4.10±0.10 to 5.70±0.10 g oil/g sample). *G. verrucosa* harvested from Trincomalee, Sri Lanka was a promising food source with the least impact from heavy metals (Cu, Zn, Fe, As, Pb and Cd; 5.77, 50.04, 421.99, 3.03, 2.35 and 0.14 mg/kg, respectively) and rich in macro minerals (Ca, Na, Mg and K; 560.53, 1112.89, 1935.81 and 3874.21 mg/kg, respectively). Hence, this study would be an introductory step for the Sri Lankan food industry to utilize *G. verrucosa* to improve the nutritional quality of foods.

Keywords: Crackers, *Gracilaria verrucosa*, protein

E-mail: isuruw@sci.sjp.ac.lk

214/B

Use of native plants in residential landscaping: Perceptions of urban residents in the Colombo District

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

[1]*Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka, Makandura, Gonawila, Sri Lanka*
[2] *Department of Biological Sciences, University of Illinois, Chicago, USA.*

Landscaping is primarily appreciated by the general public mainly for the purpose of adding an aesthetic value. Nevertheless, there is conservation and functional value underlying landscaping, which is often overlooked. Most of the urban landscapes are significantly inspired by western landscaping concepts, which comprise mostly of exotic species with more aesthetic value. Native plants are considered to be a major segment of sustainable landscaping. Native plants are the indigenous species that naturally occur in a considering region. They signify the capacity of adapting to hostile environmental conditions, preserving biodiversity and related ecological services. Even though Sri Lanka hosts for a vast pool of native flora, tendency of using them in landscaping is yet far behind. Hence, the present study was conducted to study the perceptions of the urban community in Colombo District towards the use of native plants for landscaping. A pre-tested interviewer administrated questionnaire was used to collect socio-demographic information and knowledge and attitudes of respondents (n = 150) on native plants. In addition, the plant compositions of the gardens were observed. The Chi-square test of association was used to identify the significant socio-economic factors that influence the perceptions of the respondents. According to the results, majority of the respondents (77%) were not familiar with the concept of native plants. However, the majority of respondents (71%) strongly agreed with the fact that native plants do not possess harmful effects to the environment (Mean Score = 3.97) and native plants are having more benefits compared to the exotic ornamentals (60%, Mean Score = 3.81). Conferring to the garden observations, *Azadirachta indica* (34%) was the most widely used native plant followed by *Murraya paniculata* (26%) and *Jasminum grandiflorum* (24%) among urban residential landscapes in Colombo. Apart from that *Elaeocarpus serratus*, *Mesua ferrea*, *Aegle marmelos*, *Pongamia pinnata*, *Phyllanthus emblica*, *Saraka asoka* and *Humboldtia laurifolia* were native plants occurred with less abundance. According to the results of the Chi-square test, the attitudes towards native plants were significantly influenced only by age (p = 0.001), and occupation (p = 0.012). Interestingly, education level did not denote any significant association with the attitude level. In conclusion, native plants receive a very limited attention in the landscaping context in Sri Lanka, mainly due to the limited knowledge. According to the study, only 33% of respondents were aware about the native plants. Hence, it is indorsed to improve the positive attitudes among the general public towards native plants by enhancing the awareness of the benefits of using them.

Keywords: Landscaping, native plants, residential gardens, Sri Lanka, urban

E-mail: subashini@wyb.ac.lk

301/C

Quantitative characterization of fiber composition using thermal analysis

J.M. Dayaratne* and C.L. Kalansooriya

Department of Textile & Clothing Technology, University of Moratuwa, Sri Lanka

In the textile industry, consumption of blended fabric has been drastically increased because of the improvement of properties that can gain compared to a fabric with single fiber type. With the increment of usage of blended fabric, analysis of the composition became important for different purposes such as informative labeling of garments, manufacturing process selection for fabrics, legal requirements, upcycling & recycling, research purposes, etc. Currently in the industry widely used method for quantitative characterisation of fiber composition is the chemical method. Other than that, physical methods such as microscopic analysis, quantitative separation by floatation also can be used. Even though chemical testing method is simple and precise it has many drawbacks. Specially in this process need to use hazardous chemicals. This has influence on safety issues and also it causes environmental pollution. The results also depend on the type and concentration of the chemical used and there is a higher possibility of human errors in measuring and solution preparation, so requires expert hand to perform the test. The problems with physical testing methods are it is operator intensive and time consuming. The ability of using thermal analysis methods for quantitative characterisation of fiber composition is explored through this study. Currently this method mainly used for the qualitative identification of fibers. Through this project qualitative analysis method was improved for quantitative analysis purpose. The method that is discussed in this report includes Thermogravimetric Analysis (TGA). The method was developed using TGA based on weight loss over time, and it shows more accuracy compared to chemical testing method through a statistical hypothesis testing. This study was conducted for cotton/polyester blended fabric and has the potential to be used for other fiber blends with further improvements; it eliminates the major drawbacks of the chemical testing method.

Keywords: Thermogravimetric Analysis (TGA), thermal analysis, blended fabric, fiber composition

E-mail: jithmidayaratne13@gmail.com

302/C

Studying the feasibility of a novel Alginate nanofiber based antibacterial wound dressing

N.S.L. Dissanayake

Department of Textile and Apparel Engineering, University of Moratuwa, Katubedda, Sri Lanka

A wound dressing is an essential element of standard wound care. While a wound is being treated, wound dressings act as a barrier to protect and provide a healing environment. Traditional wound dressings, however, have drawbacks, including weak barrier properties, poor haemostasis, and an easy adherence to wounds. Therefore, in consideration of the drawbacks of conventional wound dressings, it is crucial to create a novel wound dressing that prevents additional damage by low adherence to skin, has high antibacterial activity, and promotes wound healing with good breathability and waterproof property. In a wound dressing breathability is a mandatory property as transferring moisture to wound and from wounds facilitates granulation and epithelialization. Waterproofing is another important property that prevents water penetration onto the skin which may result in a low healing rate. This also avoids microbes to penetrate the wound along with water droplets. Antimicrobial property is essential for a wound dressing as the antimicrobial agents destroy the microbes and reduce the wound inflammations. This research aims to develop a novel wound dressing with waterproof, breathable, and antimicrobial properties. The dressing is comprised of two layers, the inner layer is a AgNPs-Alginate nonwoven which absorbs the exudates of the wounds and provides antimicrobial property, and the outer layer is a Polyurethane-hydrophobic silica gel electrospun nonwoven layer which have both breathability and waterproof behaviors. Sodium alginate was used as a reducing agent and stabilizer to reduce silver nitrate to silver nanoparticles. In the preparation of AgNPs, the stabilization of the nanoparticles was limited which led to agglomeration of the nanoparticles. The antibacterial wound dressing's qualities were assessed, and the results showed that it had outstanding water absorption and retaining capabilities, allowing it to absorb a significant volume of wound exudate while preserving a moist wound environment. The dressing displayed high mechanical properties and bio - compatibility. Lastly, the antibacterial activity of the inner layer was substantial against *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

Keywords: Novel wound dressing, Alginate, nanofibers, antibacterial, waterproof and breathable

E-mail: nethmidissanayake26@gmail.com

303/C

Materials on-board container ship MV X-press Pearl as it caught fire and estimates for ensuing emissions to the atmosphere

N.D. Alahakoon[1], S. Gobishankar[1], L. Zubair[2,3]* and A. Mahendran[4]

[1]*Tropical Climate Guarantee, Kandy, Sri Lanka*
[2]*Foundation for Environment, Climate and Technology, Digana Village, Sri Lanka*
[3]*Earth Institute at Columbia University, New York, USA*
[4]*Department of Chemistry & Biochemistry, California State Polytechnic University, Pomona, California, USA*

The X-Press Pearl container ship caught fire on 20ᵗʰ May 2021 when anchored 9.5 nautical miles North-East of the Colombo Port. The fire and explosions lasted until the ship sank on 2ⁿᵈ June. Our objectives are to assess the materials on board and to estimate the volume of different pollutants that may have been released into the atmosphere. Previously, we have reported on the use of atmospheric dispersion models and the interpretation of ground-based air pollution measurements. Here, a material balance was conducted to identify the materials that may be subjected to combustion and vaporization. The ship was boarded with 1486 containers of which 81 containers contained hazardous materials. Of the materials therein, about 19,500 MT were solids and 1050 MT were liquids. Of the solid phase materials, the bulk of the combustible materials were the nearly 12000 MT of polymers and plastics. Liquid phase pollutants included 864 MT of hydrocarbon oils, 235 MT of Methanol, 25 MT of Nitric acid and 57 MT of Sodium methylate. Under the conditions of the fire, the possible chemical reactions, and transformation of hazardous pollutants released into the ambient air were listed. The products from combustion include heavy metals, inorganic vapours, metal oxides, inorganic oxides, particulate matters, and oxides of metal. Based on the material inventory and its likely transformation under combustion, the ships cargo could have led a maximum of 13000 MT of atmospheric emissions (carbon dioxide and other gases, volatile organics and particulate matter). The number of containers that fell overboard are not known and if numerous, then the above could be an overestimate. However, parts of the ship too were incinerated and these are also unaccounted for. All these pollutants can be subjected to photochemical reactions, dry and wet deposition, radical formation reactions, which can increase the hazardousness of the pollutant. When these emission and effluents enter the food web, it can be to the detrimental of the ecosystem health. Particulates and heavy metals can impact the cloud microphysics and chemistry with impacts on quality and quantity of rainfall.

Keywords: X-Press Pearl, air quality, toxicants, marine disasters, ship fires

E-mail: lareef@fect.lk

304/C

Infiltration and percolation of ephemeral and perennial streams on flood control and groundwater recharge - A case study of a tributary catchment of Loggal oya

T. M. C. I. Madhushani* and P. I. A. Gomes

Department of Civil Engineering, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

This research aim was to quantify the infiltration capacity, percolation rate, and runoff generation capacity of ephemeral and perennial streams to observe groundwater recharge and flood control capacity by referring to a stream network in the intermediate zone in Sri Lanka. Infiltration and percolation tests were done at several locations in the different transverse zones of the ephemeral and perennial streams. Research objectives are specified to obtain the infiltration and percolation rates of ephemeral and perennial streams and review the implications on groundwater recharge. By following D3385-18 by ASTM standards, a single-ring infiltrometer was used to perform the infiltration test, where the infiltration is the water absorbance rate in soil. The Infiltration rate of the ephemeral streams was significantly higher than the perennial streams, one reason is the water table elevation was higher at the perennial streams. Soil percolation is simply the movement of water through the soil. A percolation test hole was placed and continued the experiments accordingly to the steps given in the BS 6297: 2007 code of practice. It was observed that the wet season percolation values were higher than the dry season percolation values. The reason could be the rise of groundwater elevation during the wet season. Furthermore, in the perennial streams, the percolation rate (Vp) was between 15 and 100 which refers to water absorption being very slow into the groundwater aquifer. But the Vp values of ephemeral streams were beyond the 15 to 100 limit and it identifies that groundwater aquifers could be polluted since water particles move rapidly through soil particles, without filtering the pollutants. Rainfall analysis shows a decrease in rainfall since 2022. Therefore, by comparing the rainfall intensity, infiltration rates, and percolation rates of these ephemeral and perennial streams, the flood risk could be negligible for this area.

Keywords: Ephemeral streams, perennial streams, infiltration, percolation, flood frequency

E-mail: charuni.imalsha98@gmail.com

305/C

Remedial techniques to mitigate hypereutrophic status in Beira Lake

N.N.N. Attanayaka[1], W.A.K.S.Fonseka[1], I.A.S.R.Ilangakoon[1], S. Himanujahn[1],
M. Vithanage[2] and B.C.L. Athapattu[1]*

[1]Department of Civil Engineering, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[2]Faculty of Applied Sciences, University of Jayewardenepura, Nugegoda, Sri Lanka

Eutrophication, excessive growth of phytoplankton and organisms that leads to an unbalanced aquatic system caused by over enrichment of nutrients. Due to human activities and urbanization, the water in Beira Lake has become enriched with nutrients mainly nitrogen and phosphorus lead to the eutrophication. Remediating the lake water will not drastically improve the water quality of the lake as it is enriched with phosphorus in lake sediments. Despite external load reductions, lake sediments may still act as a nutrient source, therefore, the eutrophication process continues all-time in Beira Lake. The effects of reduced nutrients release from sediments were studied using biochar in simulated water–sediment systems. Coconut shell was used to produce unmodified biochar because of its availability. It has received widespread attention as an adsorbent due to its efficiency in adsorbing Nitrogen and Phosphorous. Currently unmodified biochar made from coconut shell are not used widely so, coconut shell biochar used as a nutrient absorber from lake sediment. Lake sediments were collected from selected locations and overlaid by lake water in 07 experimental setups. The first two setups were prepared as models. In another four setups, sediment was mixed with biochar under 1:1 and 5:1 mixed proportion. The last setup was prepared with biochar layer above the sediment. In the first two modal average experimental setup initial phosphate concentration exceeded the acceptable limit from 1.96 mg/l to 3.04 mg/l over 51 days. In setups with sediments and coconut shell biochar, phosphate, nitrite and nitrate concentrations in water column were remarkably reduced in the first three weeks. All setups which were treated with biochar showed high efficiency of reducing ammonium. As per the results, biochar exhibits a high efficiency for treating polluted sediments, which is in line with the principles of environmentally sustainable development and it provides an advantage to adsorb and degrade pollutants. Biochar could perform comprehensive functions in sediment remediation. Furthermore, it is necessary to focus on the effectiveness of existing physical, chemical, and biological control measures with changes in hydrology and nutrient dynamics caused by environmental change.

Keywords: Beira Lake, eutrophication, biochar, sediment nutrients

E-mail: bcliy@ou.ac.lk

306/C

Assessment of groundwater vulnerability by DRASTIC-LU, Kala Oya basin, Sri Lanka

S. Himanujahn[1], D.A.N.N. Senadheeera[1], E. A. N. V. Edirisinghe[2], M. Vithanage[3]   and B.C.L. Athapattu[1]*

[1]Department of Civil Engineering, Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[2]Isotope Hydrology Section, Atomic Energy Authority, Sri Lanka
[3]Faculty of Applied Sciences, University of Jayewardenepura, Nugegoda, Sri Lanka

The study area is the Kala Oya River Basin, which spans about 2870 km^2 and is in the provinces of North Central and Northwestern regions. The primary aquifer is Regolith Aquifer of the Metamorphic Rock with small tank cascades where depth to water level ranges from 2 m to 10 m below ground level. Groundwater generally flows from Southeast to Northwest. The primary source of water for domestic, industrial, and agricultural usage is groundwater whereas in some areas of the region depending on the land use, excessive groundwater use has led to water shortages and a decline in water quality. This has served as the foundation for creating a map of the groundwater's vulnerability to contamination. The study intended to identify the impact of land use on the groundwater where the modified DRASTIC-LU model was used to evaluate the susceptibility of groundwater. The weights and ratings given to each of the inputs are added up to create the index and it shows that 7% - low susceptible zone, 40% - moderate vulnerable zone, 29% - highly vulnerable zone and 24% - extremely high vulnerability of the study area. These variations are due to an arrangement of hydrological parameters in the model. The highly vulnerable zones are in the central and eastern parts whereas the possible reason could be high net recharge which carry contaminants from the surface to the deep aquifer zones through percolation. It is also observed that the sandy clay soil texture may further help rapid infiltration. The gentle slope in the area leads to substantial time for the pollutant to infiltrate and thereby accelerating contamination process. The moderately vulnerable zone mostly matches the plowing land use pattern. The anthropogenic activity involved in this area contributes to the vulnerability of the groundwater due to agricultural practices. The variation index increased as the number of layers excluded from the DRASTIC computation increased. The removal of some layers (A, T and R) affects the vulnerability assessment, and this is demonstrated by all the sensitivity tests. However, the interpretation of some average variation indices needs further investigation. The groundwater vulnerability map can be a useful first step in the decision-making process for groundwater management and protection at the planning, policy, and operational levels.

Keywords: Kala Oya basin, DRASTIC-LU Index, groundwater vulnerability, agricultural practices

E-mail: bcliy@ou.ac.lk

307/C

Hydrologic modelling of discontinuous ephemeral streams using HEC-HMS

M.D.D. Perera[1]* and P.I.A. Gomes

Department of Civil Engineering, SLIIT Malabe Campus, Malabe, Sri Lanka

Ephemeral streams consist of more than half the length of the world's water network, with unique properties pertaining to their flow regime, but has been disregarded in importance compared to perennial streams. The flow of discontinuous ephemeral streams depends mainly on the rainfall patterns of the catchment, with their high infiltration values of the stream bed adding value to these streams in relation to groundwater recharge. Hydrological modelling of an ephemeral stream catchment was done using the software HEC-HMS in order to determine relationships between discharge and rainfall as well as peak discharge and catchment area, using input parameters consisting of field data observed from the area of Habarana in Sri Lanka, in close proximity to the Minneriya forest reserve. The modelled data, for the wet and dry seasons of the year 2020, was analyzed against observed data to derive existing relationships showcasing the success of the model. Modelling of the direct discharge using HEC-HMS showed significantly strong positive correlations (Pearson r>0.7; P<0.05) between rainfall and modelled discharge, as well as between peak discharge and drainage area for both seasons. Modelled and observed data showed strong correlations with each other (Pearson r>0.7). This study indicates the possibility of using a common hydrologic modelling software to model discontinuous streams, in order to observe their relationships with influencing hydrological parameters (such as rainfall and catchment area) on which studies are rather unfound, in hopes of aiding efforts in stream conservation.

Keywords: Ephemeral streams, hydrological modelling, runoff, infiltration, discontinuous stream flow.

E-mail: devki.d.perera@gmail.com

308/C

A study on evaluating characteristics of railway-roadway level crossings to encounter an accident-free level crossing system

A.H.M.S.P. Abeyrathne and A.G.H.J. Edirisinghe*

Department of Civil Engineering, University of Peradeniya, Peradeniya, Sri Lanka

Railway-roadway level crossings are the most dangerous accident zones which safety is a main concern. Examining the factors which are most effecting towards train-vehicle crashes and building a relationship between crashes and physical characteristics of the railway- roadway level crossing were the objectives of this research. Railway crossing characteristics, roadway physical characteristics and accident data were collected along the Colombo fort to Badulla railway line. The data were collected from field surveys and by visits to the Railway Department, the Railway Operation and Control Center in Maradana. Multiple linear regression analysis was used to relate several independent variables with accident data. The most frequent crashes occurred at railway level crossings were identified along the main railway line. Absence of full-length boom barriers at urban level crossings was one of the main reasons for accidents even though the level crossing was operated fully automatically. Model output proved several factors which were statistically significant at a confidence level of 95%. Obstruction from the left side 'High', sight distance from the right side and train speed were found to be significant by obtaining values less than 0.05 (5%). Sight distance was also found as a critical factor for crashes which was identified during the field study and it was confirmed from the model output. High growth of vegetation alongside the level crossings and illegal buildings were the main reasons obstructing the sight distance of the roadway users; therefore, government funded campaigns were recommended to eliminate the unwanted trees and illegal buildings along the railway level crossings. Current fine for trespassees that cross the level crossing after the closure of the boom gate is proposed to be increased and it is also recommended to increase the salary of a gate operator to a level such that they are enthusiastic about their job.

Keywords: Fatal crashes, hazardous, level crossings, level crossing characteristics, safety

E-mail: piyumikaabeyrathne1995@eng.pdn.ac.lk

309/C

Review on the unification of the vertical datum in Sri Lanka

K.P. Manuranga[1]*, H.M.I. Prasanna[2] and A.H. Lakmal[3]

[1]Department of Spatial Sciences, Faculty of Built Environment & Spatial Sciences, General Sir John Kotelawala Defence University, Nugegalayaya, Sewanagala, Sri Lanka
[2]Department of Surveying & Geodesy, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
[3]Department of Civil Engineering, Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

The national geodetic control network is the most important framework for surveying and mapping in any country, and it should be the framework for any surveying work such as construction, engineering, mapping, or hydrography. This network consists of horizontal and vertical components with higher-order accuracy to fulfill the survey needs of the country. Horizontal datums are geometric whereas vertical datums are mostly geopotential. Therefore, a vertical datum is based on the concept of the equipotential surface like the geoid, a particular equipotential surface that coincides with the Mean Sea Level (MSL) of the oceans. In the geodetic literature, it can be identified different approaches are used to define the vertical datums. Usually, spirit leveling, gravimetric, and tide gauge observations are used to define the Local Vertical Datums (LVDs) and low-resolution geoids are used for global vertical datums (GVDs). Currently, there are more than 100 LVDs are existing, and according to the Global Geodetic Observation System (GGOS) of the International Association of Geodesy (IAG), a unified vertical datum for the existing LVDs has many advantages. The main objective of this study is to identify the suitable method that can be used to unify the vertical datum in Sri Lanka. This review was based on the unification of vertical datums and mainly focused on the topic of the Geodetic Boundary Value Problem (GBVP) approach which was used for the unification of vertical datums in different countries or continental wide. Finally, our study revealed that the GBVP approach is the most appropriate method of unification of the vertical datums in Sri Lanka.

Keywords: Geoid, GBVP approach, geopotential, local vertical datums, unification

E-mail: manuranga.kp@kdu.ac.lk

310/C

Comparison of different height systems over a local area in Sri Lanka

W.M.N.B. Weerasooriya[*] and H.M.I. Prasanna

Department of Surveying and Geodesy, Sabaragamuwa University of Sri Lanka

The height of a point is a metric distance from a reference surface, through some specific measuring path. With different reference surfaces and measuring paths, a point can occupy more than one height. A height system is a representation of height as a coordinate system. The aim of this study was to find out the most effective and applicable height system for a local area. Orthometric, normal, and dynamic height systems and their corrections were considered and analysed in this study. Real-time kinematic (RTK) global navigation satellite system (GNSS), Gravity and precise levelling surveys were done in two different routes: one in a hilly terrain and other in approximately flat terrain. Orthometric, normal, and dynamic heights were calculated by adding relevant corrections to the precise levelling heights. Calculated orthometric, normal, and dynamic heights were compared with the results of precise levelling heights in both routes separately in order to analyse the deviations of corrections in height systems. According to the comparison, the most effective and applicable height system over this locality was the orthometric height system based on its smallest magnitude of correction.

Keywords: Orthometric, normal and dynamic heights, gravity, precise levelling

E-mail: nilitha12@gmail.com

311/C

Rapid identification of physical properties (sediment size) of beaches

E.M.M.W.C.U. Rathnayake* and R.S.M. Samerasekara

Department of Civil Engineering, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

A beach is a dynamic environment that consists of pebbly or sandy shore between high-and low-water marks. Physical properties such as particle size distribution (PSD), density, and soil type are essential for coastal infrastructure design. This research focuses to identify particle size distribution from images taken from unmanned arial vehicles (UAVs) instead using traditional methods to improve safety and convenience. The distribution of sand grain sizes on a beach can provide insight into the oceanic processes that have shaped a specific region's coastline. The size of sand grains is related to the slope of the beach. To know how best to replenish sand on a beach that is eroding, deep learning models are utilized with image processing as the main methodology. The use of the Convolutional Neural Network (CNN) concept is proposed to evaluate the particle size distribution of gravels and sand using integrated computer algorithms of image processing and analysis. The classification output classes included beach composition such as sand, and gravel (or pebbles). The verification was done by collecting the sand sample of the Marawila beach area and then, a sieve analysis was done of PSD. A computer vision algorithm was developed for the image processing technique and CNN architecture. These two methods were used to compare actual values and model values. When considering the results of CNN architecture, the prediction value range was between 88%- 99% of this CNN model. When comparing the actual PSD value and model particle distribution value, there is a difference in gravel PSD values from 40.98% - 51.98% range and sand PSD values vary by 48%. In conclusion, using UAV images and CNN architecture to identify gravel and sand particles with 88%-99% and gravel particles with 98% of prediction of PSD. Using more UAV images provides a more accurate prediction for testing images. Therefore, more sand and gravel images are needed to obtain better values. Furthermore, this study can be extended to identify more particles which are similar to clay and pebbles by training CNN using clay and pebble images which will help to evaluate more accurate particle distribution values and accurate validation.

Keywords: Physical properties, beach, image processing, Convolutional Neural Network (CNN), aerial Images

E-mail: curathnayake@gmail.com

312/C

Strength improvement of soft soil mixed with plastic chips and cement

E.M.K.G.A.D.B. Ekanayake[1] and W.M.N.R. Weerakoon*

Department of Civil Engineering, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Soft soil stabilization is a usual practice in the construction industry to improve physical characteristics. Normally, cement and lime are used in soil stabilization processes to increase strength characteristics. Although with the depletion of raw materials for cement manufacturing, ideas have developed about several alternative methods for soil stabilization. In addition, the soil conditions for the construction sites worsen with time due to the human activities. In this study polyethylene terephthalate (PET) chips and ordinary portland cement (OPC) were mixed into the soft soil samples obtained from the Bellanwila Marshlands to improve the strength characteristics. Atterberg limit tests, particle size distribution and standard proctor compaction tests were conducted to identify the properties of the untreated soft soil. Liquid limit and plastic limit were obtained as 46% and 23.34%, respectively. The optimum moisture content is 35.2% while the maximum dry density is 882 kg m^{-3}. The main scope of the research project was attained by conducting the unconfined compressive strength (UCS) test and direct shear test (DST). For 2 different PET chip sizes of 5 mm and 10 mm, a total of 12 mix proportions were prepared according to the volume-based ratio by mixing 5%, 10% and 15% PET content with 3% and 6% OPC content. The 36 specimens for UCS and 12 specimens for direct shear were tested for 4 curing periods such as 3, 7, 14 and 28 days. According to the test results, treated samples have shown a noticeable strength improvement compared to the original soil. UCS and shear strength increased with the addition of OPC and PET contents for all curing periods. The size of the PET chips has influenced the increase in both UCS and shear strength values. After the soil stabilization, the sample with maximum cement percentage (6%) and maximum amount of larger plastic chips (15% of 6 mm size plastic chips) displayed the optimum results by attaining UCS of 18.15 kPa and shear strength of 40.98 kPa after 28 days.

Keywords: Soft soil, OPC, UCS test, direct shear test, waste PET bottles

E-mail: weerakoon@sjp.ac.lk

401/D

Biophysical characterization of PEG-based extracellular vesicles isolated from tuberculosis patients using Dynamic Light Scattering technique

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

[1]Molecular Microbiology & Human Diseases Project, National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Respiratory Disease Treatment Unit, General Teaching Hospital, Kandy, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

Dynamic light scattering (DLS) is a simple and efficient method for nano-particle size and shape measurements. Recent studies suggested the differences seen in the shape and size distribution of extracellular vesicles (EVs) in different biological fluids may have the potential to discriminate different pathological conditions and provide useful information for clinical diagnosis. In Sri Lanka, this is the first attempt to biophysically characterize EV subpopulations isolated using a low-cost PEG-based EV isolation method from tuberculosis patient sera which is applicable for TB diagnosis in low-middle income countries. A total of 60 serum samples were collected and grouped into clinical cohorts of active tuberculosis (ATB, n=15), latent tuberculosis (LTB, n=15), household contacts (CT, n=15), and healthy individuals (HC, n=15) attending to the Kandy Chest Clinic. The EVs were isolated using the combined 8% polyethylene glycol (PEG)6000 precipitation and filtration (0.22 μm-polyethersulfone) method. The isolated EVs were morphologically characterized using the Renishaw inVia Raman spectrometer (Renishaw, UK) and the Olympus CKX41 inverted phase-contrast microscope and were biophysically characterized using the Nanoparticle analyzer, nanoPartica SZ-100V2 Series (HORIBA) based on two parameters; intensity-weighted particle size (Z-average) and the polydispersity index (PDI). For each clinical cohort, 45 measurements were taken and the results were statistically analyzed using One-way ANOVA (CI<0.05%), SPSS software v.28.0.1.1. Firstly, EVs were morphologically identified as sphere-shaped vesicles with an intact membrane which is consistent with previous studies. Based on the Z-average (nm) measurements (HC=120.336±2.996, CT=168.054±14.773, LTB=157.394±9.142 and ATB=302.158±38.672) and PDI values (HC=0.493±0.013, CT=0.627±0.011, LTB=0.490±0.019 and ATB=0.559±0.033) following clinical groups were statistically significant; Z-average: ATB and LTB, ATB and CT, and, ATB and HC and PDI: HC and CT, CT and LTB, thus could be differentiated using the DLS technique. Furthermore, increased PDI values (0.1-0.7) indicate the samples were highly polydisperse. Differences among PDI values of different clinical cohorts may be due to the alterations of the lipid bilayer composition as a result of the pathological condition. In conclusion, DLS can be used to differentiate tuberculosis patients from healthy individuals mainly based on the Z-average. However, a major limitation of this technique is, that several freeze-thawing could affect the particle size measurements.

Keywords: Extracellular vesicles, dynamic light scattering (DLS), polydispersity index (PDI), serum, tuberculosis, Z-average

E-mail: dhammika.ma@nifs.ac.lk

402/D

Isolation and evaluation of endophytic fungi found in *Cinnamomum dubium* (Wild Cinnamon) for their antibacterial activity

N. N. Mendis[1] and P. B. Ratnaweera[2*]

[1]College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya, Sri Lanka
[2]Department of Science and Technology, Uva Wellassa University, Badulla, Sri Lanka

Antibiotic resistance is a growing public health concern due to the misuse and overuse of antibiotic drugs. Therefore, there is an increasing interest among the scientific community to discover new natural product related drug leads. Endophytic fungi remain a largely untapped source of interesting and bioactive compounds that may potentially show potent antibacterial activities. Especially endemic plants may be a habitat for novel endophytic fungi due to the specificity of their geographic location. Within such a context, this study aimed to isolate and evaluate the antibacterial properties of endophytic fungi from *Cinnamomum dubium*, which is a wild variety of cinnamon endemic to Sri Lanka. Eight endophytic fungal isolates (CdEn 01-08) were obtained from the leaves and bark of this plant, and all of them displayed varying levels of antibacterial properties against one or more of the tested bacteria, *Staphylococcus aureus*, *Bacillus cereus* and *Escherichia coli*. The ethyl acetate extract of endophytic fungus CdEn 01 showed the greatest activity, as it displayed antibacterial activities against all three bacteria with inhibition diameters ranging from 7.5-12.0 mm at a concentration of 200 µg/disc and 8.5-13.0 mm at a concentration of 400 µg/disc. This was followed by the ethyl acetate extracts of CdEn 05 and CdEn 06 endophytes, which yielded inhibition zone diameters against *Bacillus cereus* and *Escherichia coli* ranging from 7.0-8.0 mm and 7.0-7.5 mm at 200 µg/disc concentration respectively, and 8.0-9.0 mm and 8.0-9.2 mm at 400 µg/disc concentration respectively. A thin layer chromatography analysis indicated the presence of mainly polar compounds in all of the ethyl acetate extracts. This is the first study ever to report the isolation and evaluation of antibacterial properties of endophytic fungi from *Cinnamomum dubium*.

Keywords: Antimicrobial activity, *Cinnamomum dubium*, endophytic fungi, antibiotic resistance, endemic plant

E-mail: pamoda.b@gmail.com

403/D

Salinity tolerance of *Aedes sp* mosquitoes and its impact on dengue cases in Batticaloa district

W.A.D. Shashikala Keshani* and M. Vinobaba

Department of Zoology, Eastern University, Sri Lanka

Mosquitoes are disease vectors that cause deadly diseases, especially in tropical regions of the world. Batticaloa district is one of the highest dengue cases reported district among the ten highest dengue cases (12.47%) reported districts in Sri Lanka, during the past five years. Salinity tolerance ability increases the breeding sites of mosquitoes apart from the standard potential freshwater bodies. Therefore, the objective of the current study was to measure the maximum amount of salinity that mosquitoes can tolerate and then identify potential breeding sites rather than fresh water. A total of 330 water samples from 33 naturally breeding locations in four dengue hotspots (Batticaloa, Eravur, Oddamawadi and Valachchenei) in 14 Medical officers of Health (MOH) areas in the district of Batticaloa were collected from August 2021 – November 2021. A ladle dipper was used to obtain samples of larval mosquitoes. Larval species were identified microscopically using standard taxonomic keys. Physicochemical parameters such as temperature, Dissolved Oxygen (DO), pH and salinity of the natural breeding streams water were measured *in-situ* using digital meters. *Aedes aegypti* and *Aedes albopictus* collected from field study were separated into four colonies according to the hotspot and reared. After emerging of first progeny 1st instar larvae and 3rd instar larvae of both species were exposed to different salinity levels of 0, 2, 4, 6, 8, 10, 12, 14, 16, 20, 21 and 22 ppt under the laboratory conditions. Probit analysis was performed to determine salinity tolerate of *Aedes* mosquitoes. Overall, a total of 420 *Ae.aegypti* and 386 *Ae.albopictus* were collected from different breeding habitats including boats. The abundance of *Aedes sp* mosquito larvae showed a significant positive correlation ($p < 0.05$) with physico-chemical parameters in breeding habitats, such as temperature (32 °C), DO(20 mgl^{-1},) and salinity(12 ppm). *Ae. aegypti* larvae reported in boat with having small amount of water in the bottom with 10 ppt (max) salinity level. *Ae. albopictus* larvae were reported from the small water pools in the edge of the Batticaloa lagoon with 7 ppt (max) salinity level. According to the results obtained from the salinity tolerance laboratory study both *Aedes* species showed 18 ppt salinity tolerance. The current study concluded that dengue vector mosquitoes can breed in high salinity water mostly found in the Batticaloa District. This may be the reason for reporting high dengue cases in the district and knowledge generated on the ecology of dengue vector mosquitoes will help to eliminate dengue from the country.

404/D

Effects of climatic factors on the larval densities and insecticide susceptibility status of *Anopheles subpictus* in Hambantota District

S. Priyadarshani[1], G.R. Ranawaka[2], P.J. Jude[2] and H.T.R. Jayasooriya[2]*

[1]Anti Malaria Campaign, Narahenpita, Colombo 5, Sri Lanka
[2]Department of Zoology, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Understanding the insecticide susceptibility status of malaria vectors and their sensitivity to climatic variables is important in implementing necessary vector control decisions. This study aimed to examine the effects of climatic factors (total rainfall (RF), mean temperature (MT), and relative humidity (RH)) on *Anopheles subpictus* larval density and the insecticide susceptibility status of *An. subpictus* mosquitoes in the Hambantota district. Arabokka, Mirijjawila and Harbour localities in the Hambantota Medical Officer of Health (MOH) area were selected as study sites in the Hambantota district. Cattle baited trap collections and larval sampling were carried out monthly from October 2021 to March 2022. Meteorological data were obtained from the Department of Meteorology, Sri Lanka. The relationship between *An. subpictus* larval densities and climatic variables were analyzed using Pearson correlation. A significant negative correlation was observed between RH of current month with the density of *An. subpictus* larvae in Mirijjawila (p=0.045) and Harbour (p=0.04) sites. The MT of the current month did not show a significant relationship with *An. subpictus* larval density. Negative correlations were observed between *An. subpictus* larval density and one-month lag periods of RH and two months lag periods of MT in both Mirijjawila (RH; p=0.037, MT; P=0.001) and Arabokka (RH; p=0.008, MT; p=0.045) study sites. Rainfall of the current month showed a negative significant correlation (p=0.001) with the density of *An. subpictus* larvae in Harbour site. Insecticide susceptibility tests were carried out for the first generation (F_1 progeny) of *An. subpictus* adults in Hambantota MOH using Lambdacyhalothrin 0.05%, Deltamethrin 0.05%, Dichlorodiphenyltrichloroethane (DDT) 4%, Malathion 5% and Propoxur 0.1%. *An. subpictus* population in Hambantota district was observed to be 'possible resistant' to Deltamethrin 0.05% and susceptible to all other tested insecticides. Further, 100% mortality was observed in PBO+Deltamethrin exposed *An. subpictus*, indicating the resistance to Deltamethrin may be due to a detoxication of the insecticides by either esterase and/or mixed function oxidase activity of the mosquitoes. Further studies are required to understand the molecular mechanisms of resistance in *An. subpictus* population in the Hambantota district.

Keywords: Climatic factors, larval density, meteorological data, *Anopheles subpictus*

E-mail: htjay@ou.ac.lk

405/D

Tracking the lesser-known migratory routes of *Larus heuglini* (Heuglin's Gull), from Sri Lanka to the Arctic circle

P.A.B.G. Panagoda[1,2], T. Mundkur[3], S. Balachandran[4], S.W. Kotagama[1], M. Fanjuan[5], Z. Beixi[5], Cao Lei[5] and S.S. Seneviratne[1,2*]

[1]Field Ornithology Group of Sri Lanka, University of Colombo, Sri Lanka
[2]Avian Sciences and Conservation, University of Colombo, Sri Lanka
[3]Wetlands International, 6700 AL Wageningen, The Netherlands,
[4]Bombay Natural History Society, Hornbill House, Mumbai, India,
[5]State Key Laboratory of Urban and Regional Ecology, Chinese Academy of Sciences, China

Larus heuglini (Heuglin's Gull) is one of the largest gulls with a white head, found along the coasts of Northern and North Western Sri Lanka, during the migratory season. It is a species of the Lesser Black-backed Gull, *Larus fuscus* complex whose migration and breeding origins of the South Asian wintering populations are not well understood. Our study aimed to track the route of Heuglin's Gulls for the first time from South Asia to their breeding grounds, to understand their migration ecology and Sri Lanka's connectivity to the rest of the Central Asian Flyway through satellite telemetry. During March-April of 2021 and 2022, three adult Heuglin's Gulls were caught on their non-breeding site in Mannar Island of Sri Lanka (9.0585° N, 79.8185° E), and fitted with GPS-GSM transmitters, just before commencing their northward migration. As of June 2022, we obtained information on migratory movements covering three northward and two southward migrations, involving more than one full annual migration cycle. All three birds traveled to the Yamal Peninsula of the high arctic (70.6708° N, 70.1367° E) to breed during the boreal summer. Following breeding, two of them returned to their non-breeding grounds located in the Indian Sub-continent: Mannar, Sri Lanka and Maharashtra, India. We found that one gull which spent the non-breeding period in Mannar in 2020-2021, spent the following season in Maharashtra. The spatial and temporal characterization of these migrations is shown in Table 1. As a result of tagged birds spending more time in the stopover sites during southward migration (30.0 ± 2.8 days) than the northward migration (18.7 ± 5.9 days), the southward migration was slower (178.0 ± 8.9 km/day) compared to the northward migration (223.0 ± 52.5 km/day). Our findings provide the first definitive evidence for the breeding origin of South Asian Heuglin's Gulls. Our study further highlights the migratory connectivity between Sri Lanka and the arctic circle.

Table 1: Distances and temporal aspects of northward and southward migration, for three Heuglin's Gulls tracked by satellite telemetry

	Northward migration Average (Range)	Southward migration Average (Range)
Onset of migration	13 Apr (1 - 24 Apr)	18 Sep (29 Aug – 9 Oct)
Arrival at breeding/ non-breeding ground	31 May (15 May – 18 Jun)	13 Nov (4 – 23 Nov)
Duration of migration (days)	43.3 (35-55)	56 (45-67)
Total migration distance covered (km)	9,302.7 (8,943-9,956)	9,899 (8,292-11,505)
Migration speed (km/day)	222.9 (162.6-257.4)	178.0 (171.7-184.3)
Stopover duration (days)	18.7 (12-23)	30 (28-32)
No. of stopovers	5.3 (5-6)	7.5 (7-8)

Migration speed is the overall migration speed, including stopover time.

Keywords: Heuglin's Gulls, *Larus heuglini*, migration, Central Asian Flyway, Mannar
E-mail: sam@sci.cmb.ac.lk

501/E1

Surface enhanced Raman sensing of glucose on electrodeposited cubic-ordered copper thin films

L.A.G.D. Jayasekera[1], K.D.R.N. Kalubowila[1,2], J.L.K. Jayasingha[1,2], H.H.E. Jayaweera[1], M.S. Gunewardene[1], D.P. Dissanayake[3] and J.K.D.S. Jayanetti[1,2]*

[1]*Center for Instrument Development, Department of Physics, University of Colombo*
[2]*Department of Instrumentation and Automation Technology, University of Colombo*
[3]*Department of Chemistry, University of Colombo*

Copper (Cu) based materials have gained interest as low-cost sensing substrates for surface-enhanced Raman spectroscopy (SERS). Cu/Cu_2O thin films were obtained first by electrodeposition of Cu_2O thin films on titanium (Ti) substrates in an acetate bath followed by partial reduction to Cu using ascorbic acid. The morphology of the substrate was controlled by varying the pH of the bath accordingly. The length of the sides of cubic structures were confirmed to be in the order of 400 nm by scanning electron micrographs. Physiologically relevant concentrations of D-glucose (140 mg/dL) were placed on these thin films and were illuminated using a 532 nm laser to observe Raman spectra using a research-grade Raman spectrograph. The Raman spectral peak associated with the bending mode of H–C–H in D-glucose near 1400 cm^{-1} was enhanced by a factor of 16.0 ± 0.2 compared to the Raman signal obtained on bare Ti substrates. To isolate the SERS contribution from Cu/Cu_2O cubic structures, a pure Cu thin film electrodeposited on Ti using an acetate bath was used for Raman spectral measurements. These films had reported a much lower enhancement of only 4.4 ± 0.1 for the same D-glucose Raman spectral peak. Therefore, both ordering of the surface structures as well as increased surface area have significantly contributed to the surface-enhanced Raman scattering. The cubic-ordered $Cu/Cu_2O/Ti$ thin films thus provide a novel SERS platform for detecting D-glucose using a low-cost synthesis route. Determining the limit of detection and minimizing oxidation of Cu will remain important to fully realize the potential of these thin films as SERS-based sensors.

Keywords: Raman sensing, D-Glucose, electrodeposition, Cu/Cu2O cubic structures, surface enhancement

E-mail: sumedhajayanetti@gmail.com

502/E1

Developing high hardness tread compound for the solid tyre *via* varying the filler content

R.K.W.B. Wickramarathna and W. Wasanthi P. De Silva*

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

Tyre tread material affects the characteristics of vehicles such as ride & handling, rolling resistance, fuel consumption, the durability of tyres, noise, and vibration. Hardness is the property that enables a tyre to resist abrasion, indentation, cutting, and scratching. In industry, tyre hardness is determined by using a Durometer (shore A hardness tester). This study aimed to develop a new solid tyre tread compound with a Shore A hardness between 80–85 and to check other physical properties such as tensile strength, specific gravity, hardness, rebound resilience and abrasion test. The hardness was enhanced by altering the filler component to attain this goal. Carbon black and silica were used as reinforcing fillers. The use of Carbon black has drawbacks of high rolling resistance and processing difficulties. Therefore, silica was used as the hardness-improving filler. The incorporation of silica has given outstanding properties like low rolling resistance, high abrasion resistance, high wet grip, and high load-carrying capability. Different tyre tread formulae were prepared by varying the silica ratio from 40 parts per hundred rubbers (phr) to 80 phr. Optimum properties were obtained at 70 phr with a blend of natural and synthetic rubber. In the optimum formulae, shore A hardness was 82, rebound resilience value of tread compound was 43%, tensile module at 300% elongation of tread compound was 166.94 kg cm^{-2}, and the tensile strength of tread compound was 226.83 kg cm^{-2}, and elongation at break of tread compound was 423%. A successful tyre tread compound was developed using a natural and synthetic polymer blend with a 70 phr silica filler component. A tyre was manufactured using the optimal formula and a quality endurance drum test (QED) was done for the tyre, which gave a 350 min run time and comparatively low heat buildup. This kind of tyre can be used for industrial purposes like mining vehicles and trucks that are exposed to ground and road hazards.

Keywords: Solid tyre, tyre tread, hardness, silica, quality endurance drum test

E-mail: wasanthidesilva@sjp.ac.lk

503/E1

Investigation of surface wettability of naturally occurring superhydrophobic surfaces across geographical locations in Sri Lanka

W.D.G.M. Senarathna* and S. Jayawardhana

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

An ever-increasing number of research publications are being produced each year relating to natural superhydrophobic materials. Nevertheless, there are discrepancies between research findings on the water contact angle across many of these superhydrophobic surfaces. Therefore, these results are not directly comparable or reproducible. A part of this discrepancy could be attributed to the lack of standardization in the measurement procedure of contact angles while the natural variability in and across sample surfaces could also contribute to the deviation. The aim of this study was to gain an understanding of the natural variability across sample surfaces, by using Taro (*Colocasia esculenta*), Lotus (*Nelumbo nucifera*), Canna (*Canna coccinea*) leaves and Rose (*Rosa*) petals with precision measurement of water contact angles while utilizing a standardized drop shape analysis technique. Samples were collected from Gampaha, Colombo, Kegalle, Anuradhapura and Matale districts and contact angles were measured. It was apparent that there is a considerable difference in the superhydrophobic behavior of these samples possibly arising out of the climatic adaptations across different geographical locations. The measurements showed that the contact angle variation of Lotus leaf, which is the most cited superhydrophobic surface was between $157.6° \pm 0.7°$ to $164.1° \pm 0.4°$, while a plant surface such as a Rose petal had a variation between $141.2° \pm 2.9°$ to $160.9° \pm 0.6°$. In addition, Taro leaf had a variation between $153.4° \pm 1.8°$ to $160.3° \pm 1.5°$ and Canna leaf had a variation of $144.0° \pm 3.2°$ to $161.5° \pm 2.3°$. These values are in line with the values reported in literature and establishes that the discrepancies in reported values could be attributed to the natural variability in wettability of plant surfaces of the same species across different locations. In addition, scanning electron microscopy images were taken to study the nano/microstructures of the selected natural superhydrophobic surfaces.

Keywords: Superhydrophobic, water contact angle, lotus leaf, taro leaf

E-mail: madhushanisenarathna96@gmail.com

504/E1

Synthesis of *n*-type Copper(I) Oxide (Cu₂O) thin films by the low-temperature thermal oxidization of electroplated Copper (Cu) nanoparticles

L.W.P.M. Madusanka[1] and P.K.D.D.P. Pitigala[1,2]*

[1]Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Center for Advanced Material Research, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The *n*-type copper(I) oxide (Cu_2O) is a promising material to replace the conventional TiO_2 layer in dye-sensitive solar cells. The thin film Cu_2O was produced on an indium tin oxide (ITO) coated glass substrate by the low-temperature thermal oxidation of electroplated copper nanoparticles. The electrical properties, morphological properties and purity of the thin films were determined using Mott-Schottky analysis, scanning electron microscopy (SEM) and Raman spectroscopy. First, copper (Cu) nanoparticles were electrodeposited on ITO glass (the working electrode), utilizing a copper sheet as the counter electrode and an electrolyte containing copper(II) sulfate ($CuSO_4$) as the primary ion source, sulfuric acid (H_2SO_4) to acidify the medium, and sodium chloride (NaCl) and poly(ethylene glycol) (PEG) as the additives. Then, Cu_2O thin film was produced by fully converting the electrodeposited Cu by low-temperature thermal oxidation method by only using $CuSO_4$ solution without any additives. After analyzing of the observed results, SEMs showed that the maximum number of Cu_2O crystals is in the range of 2.7–3.6 μm size, and the Mott-Schottky plots showed that Cu_2O exhibits an *n*-type conductivity with the donor concentrations in the range of $4.30 \times 10^{18} - 2.07 \times 10^{20}$ cm^{-3}. The prominent three peaks of the Raman spectra, $144.4, 525.2,$ and $620.7 \ cm^{-1},$ confirm the presence of only Cu_2O in its structure when employing this method, with no contaminants such as copper (II) oxide (CuO). Hence, this study demonstrates a simple and low-cost approach to fabricate *n*-type Cu_2O thin films.

Keywords: Copper(I)oxide, thermal oxidation, nanoparticles, thinfilm, semiconductor

E-mail: dpitigala@sjp.ac.lk

505/E1

Determination of the g-modes of three Delta Scuti variable stars using Kepler data

R.D.D. Jayatissa[1], J. Adassuriya[2*], M.L.C. Attygalle[1] and K.P.S.C. Jayaratne[2]

[1]Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Astronomy and Space Science Unit, Department of Physics, University of Colombo, Sri Lanka

Asteroseismology is a study of stellar interiors using their surface pulsations. It is one of the best methods to do such studies where oscillations are analyzed to detect modes of stellar pulsations. There are two pulsation modes, pressure modes (p) and gravity modes (g). The buoyancy is the restoring force for g-mode, and the gas motions are primarily horizontal. The frequencies of g-modes are less than five cycles per day. These g-modes are concentrated more at the core of the star and used to determine the amount of core hydrogen in the stellar. Hence, the stellar age, internal rotation, and gas mixing can be obtained. In this study, frequency analysis was done for three Delta Scuti pulsating stars KIC 71195304, KIC 9775454, and KIC 10536147 using the long cadences data sets obtained from the KASOC database. The pulsation frequencies of the targets were determined by applying discrete Fourier transformation with the pre-whitening process. The Échelle diagrams were plotted to determine the degrees (l) of detected frequencies according to the frequency spacing. The dominant g-mode fundamental frequency for the target Delta Scurti Star, KIC 71195304 was determined as 4.19379761 d^{-1} accompanied by a frequency multiplet where the non-radial frequencies of $l = 1$ triplet with the frequency spacing of 0.004 d^{-1} were detected. In this study, twenty-three g-mode frequencies were detected for KIC 71195304. Furthermore, the dominant p-mode fundamental frequency was determined as 14.9382253 d^{-1} for the target KIC 9775454 accompanied by a frequency multiplet where the non-radial frequencies of $l = 1$ triplet with the frequency spacing of 0.004 d^{-1} were detected. There were nineteen g-mode frequencies detected for the target KIC 9775454. The dominant g-mode fundamental frequency was recovered as 0.21985058 d^{-1} for KIC 10536147 with nine more g-mode frequencies. All three Delta Scuti stars have g-mode frequencies and further investigations should be recommended.

Keywords: Asteroseismology, Delta Scuti stars, gravity modes, light curves, photometry

E-mail: janaka@phys.cmb.ac.lk

506/E1

A correlation study of voice parameters extracted from a smartphone and a reference microphone

U. Weerasinghe and R.V. Coorey*

Department of Physics, University of Colombo, Sri Lanka

Maintaining good vocal health is vital for successful communication with other human beings. However, several diseases threaten to damage vocal cords temporarily or permanently, rendering the human voice hoarse and difficult to understand. In the present work, a correlation study of voice parameters extracted from an Android smartphone and a studio-grade microphone in a sound-controlled environment was carried out. In this study, 20 subjects were requested to provide 9 voice samples each of the three vowel sounds /a:/, /i:/, and /u:/, each in 3 different pitch levels high, normal, and low. Next, the five parameters: fundamental frequency (F0), jitter, shimmer, harmonic-to-noise ratio (HNR), and signal-to-noise ratio (SNR) were extracted from each audio file, and the correlation between the values obtained for each of the 5 parameters for the 9 types of samples was analyzed. This was performed in three subsets for male voices, female voices, and all voices. The data shows that the F0 (0.9990), jitter (0.9601) and HNR (0.9820) parameters exhibit a high correlation compared to the shimmer (0.5867) and SNR (0.6991) parameters in all three cases. In male voices, the best sample type regarding the correlation between smartphone and reference microphone measurements was the low-pitched /a:/ sound, whereas the high pitched /a:/ sound provided the highest correlation values for female voices. When considering the combined dataset, all three low-pitched samples provided excellent correlation values and would be most suitable for smartphone voice disorder detection. Despite all five parameters having a positive overall correlation, the lower correlations of the shimmer and SNR parameters indicated that they would not be suitable for a classification algorithm. According to the results of this study, it can be concluded that the fundamental frequency, jitter, and harmonic-to-noise ratio showed excellent correlation between the measurements taken from both microphones, whereas the shimmer and signal-to-noise ratio exhibited weak correlation.

Keywords: Voice parameters, smartphone, vowel sounds, pitch levels

E-mail: ramal@phys.cmb.ac.lk

507/E1

Modeling climate variables in the Colombo city to identify possible near-future impacts of climate change

N.K. Kularathne and M.M.P.M. Fernando*

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

Climate change has been caused by anthropogenic greenhouse gas emissions since the industrial revolution and is one of the major environmental threats to the planet today. While the fluctuations in atmospheric greenhouse gas concentrations and global temperature are not strange phenomena for the Earth, such natural variations took place over periods of thousands to millions of years in the past, allowing the ecosystems to adapt and mitigate. However, the current warming effect occurred within 100–150 years making it difficult to adapt to climate change. As a developing nation, Sri Lanka is highly vulnerable to its environmental and socioeconomic impacts. Therefore, this study intends to analyze the historical climate variable data (temperature and precipitation) in Colombo city to develop statistical forecast models to generate near-future projections. Colombo city was chosen because it is the commercial capital of the country. The meteorology station in the Bauddhaloka Mawatha, Colombo 7 (Latitude: 6.905, Longitude: 79.871) was selected as the reference location. Historical temperature and precipitation data from the Meteorology Department of Sri Lanka (from 2011 January to 2021 October), Climate Research Unit Time Series (CRU TS) (from 1901 January to 2020 December), Climate Hazard Center Infrared Precipitation with Station (CHIRPS) (from 1991 January to 2020 December), and the Canadian Earth System Model Version 5 (CanESM5) available in the Intergovernmental Panel on Climate Change (IPCC) Working Group 1 Interactive Atlas were used in this study. The accuracy of data from open access repositories were verified using land station data. Afterward, seasonal autoregressive integrated moving average (SARIMA) modeling and downscaling of the CanESM5 using a regression-based transfer function according to the IPCC 1.5 °C global warming scenario were used as forecast mechanisms for the average temperature. These statistical techniques failed to generate accurate models for precipitation data because of their high volatility. Therefore, precipitation data were analyzed using the visual properties in the historical data plots. Increasing trends were observed in both modeling methods for average temperature. However, the annual precipitation in each month displayed increasing, decreasing, and unvaried trends over the study period. Wolfram Mathematica 12.3 software was used as the computational tool in this study.

Keywords: Climate data modeling, Colombo city, climate change, SARIMA, statistical downscaling

E-mail: nirmalkavindra@gmail.com

508/E1

Building on prior knowledge: A focus on teaching limit of a function

D.R.N.N. Rathnayake* and G.N.Jayakody

Department of Science for Technology, Faculty of Technology, University of Sri Jayewardenepura, Pitipana, Sri Lanka.

This qualitative study aims at investigating the efforts made by mathematics teachers in Activating Prior Knowledge (APK) of students in teaching the limit of a function. The concept of limit is fundamental to calculus. However, its inherently abstract nature disrupts the student's conceptual understanding. Learning limits demands a high level of prior knowledge on functions. Hence, recalling the prior knowledge accelerates new learning and influences student engagement and achievement. According to Piaget's theory of cognitive development, APK stimulates and prepares learners to build new schemas on existing schemas. It is bound by constructivism, which believes that new knowledge is built through cognizing the subject, but not through passive transmission. APK facilitates teaching by uncovering ambiguities on a student's existing knowledge, screening students with low prior knowledge and tracing student misconceptions. Data for this study drawn from a two-year funded research that explores secondary teachers' Mathematical Knowledge for Teaching (MKT) in teaching limits and derivatives. Twelve secondary mathematics teachers working in 9 different schools located in Colombo, Gampaha and Kalutara districts were chosen as participants. Each teaching session lasted for two periods and data was collected through lesson observations and field notes. Video recorded lessons were transcribed and qualitatively analyzed. It was found that some teachers deliberately recalled knowledge on function notations, function values, rational functions, infinity, domain and range, through discussion prompts and examples. They elaborated the difference between calculating the function value and limit value at a particular point; hence, spontaneously created links between prior knowledge to new learning. However, majority of the teachers created limited or zero opportunities to elicit prior knowledge. Some exhibited conventional teaching approach by directly starting the informal definition of limit. Results indicate that teachers' motivation for APK was not satisfactory. Teachers could integrate a variety of warm-up activities like presentations, discussion prompts, tests and worksheets in order to retrieve prior knowledge, create memory links and to assess students' readiness for the lesson. Students also need training on self-regulation and meta-cognition to APK by themselves. This study calls for professional development programs and workshops to inform and develop secondary mathematics teachers' subject matter and pedagogical content knowledge in teaching mathematics.

509/E1

Identifying posture errors in Kandyan dancing using discrete Fourier transform

I. U. Amarawickrama* and D. S. Rodrigo

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

Kandyan dancing is considered as the traditional dance of Sri Lanka and holds an eminent place in Sri Lankan culture. The method of developing skills in Kandyan dancing depends on the real-time guidance of the teacher. However, for several reasons, dancers have to practice dancing without the real-time guidance of the teacher. Hence, dancers need to have an appropriate solution to assess their performance by themselves. Discrete Fourier Transform (DFT) is the technique that is used to convert a discrete signal in the time domain into the frequency domain. This technique can be used to decompose a complex signal into simpler parts in order to facilitate the analysis using the Fast Fourier Transform (FFT) amplitudes. The first Goda Saramba of Kandyan dancing was modeled as FFT amplitude spectrum for each lower body angle and upper body angle under the rhythm Wilamba. For the formulation of this model, five Pahim Path qualified female dancers weretaken as the sample. Then the constructed models were used to identify the five basic posture errors, which occurred in the performance of an amateur Kandyan dancer. According to the results, a set of incredible information on basic postures of the first Goda Saramba, was contained within the first eight harmonics of the obtained FFT amplitude spectrums for each considered angle. The error performances, over bending of Mandiya and the insufficient bending of Mandiya, were identified from the 2nd to 8th harmonics of the amplitude spectra obtained for hips and knees. The error performances over gap between palms and the insufficient gap between palms were identified using the fundamental of amplitude spectra obtained for shoulders, elbows and spine shoulder, while the error performance drop of the elbows was identified using the fundamental amplitude spectra obtained for shoulders and elbows. Finally, this research may be introduced as a mathematical and technological procedure for the self-assessment of dance performance and a self-identification method for posture errors without using the concept of optical flow analysis of dancing.

Keywords: Kanydan dancing, posture error, discrete Fourier transform, mathematical modeling, self assessment technique

E-mail: isuumaya@gmail.com

510/E1

Construct an AI based stock market index

L.D.S. Dilshan* and E.R.A.D. Bandara

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

A stock market is a very important financial market for every country and the stock market indices are used to evaluate the performance of the stock market. The importance of the stock market indices has made it an interesting topic to researchers over the years. Artificial Intelligence (AI) has influenced almost every domain in the world due to its benefits. Over the past years, it can be identified that several studies have been conducted on applying AI to the stock market and stock market indices. Therefore, the study was carried out to construct an AI based stock market index to avoid the difficulties and weaknesses in stock market indices, which are being used in Sri Lanka. The period between 2012–2020 was considered for the study. When considering the period, it could be identified that the market index has been influenced by the financial news. Therefore, a sentiment analysis for financial and stock market news was conducted using Natural Language Processing (NLP) and AI techniques, and constructed the new stock market index using the sentiment results. The Long Short Term Memory (LSTM) networks were used for the sentiment analysis to achieve better results and the accuracy of sentiment analysis was around 72%.
The new index given by the equation was a market capitalization-weighted index.

$$New\ Index = \frac{M + (s \times m \times f)}{divisor}$$

where M – free float adjusted marked cap

s – result of the sentiment analysis (-1 for negative sentiment, +1 for positive and 0 for negative)

m – mean market cap based on the sentiment

$f = \dfrac{minimum\ market\ cap\ change\ between\ two\ days\ for\ the\ period}{maximum\ market\ cap\ between\ two\ days\ for\ the\ period}$

Under the concept of comparing the growth or loss of market based on a pre-determined market cap, the free float adjusted market cap of 2012 was used as the divisor of the equation. The new index was constructed as a free-float adjusted index to avoid the drawbacks of the current All Share Price Index of Colombo stock exchange. Rather than just using the market cap, the result of the news sentiment analysis and the change of market cap between two days were used as the factors of the index construction. The new index was evaluated using the Return on Index (ROI) and the new index returned an ROI of 13% for the period. It was the second-highest value for the period of 9 years and the highest ROI, 35% was given by the ASPI. But for 5 years, the maximum ROI had been returned by the new index. It is suggested to evaluate the index using other metrics to finalize a proper AI based stock market index.

Keywords: Stock Market Index, AI, sentiment analysis, free float adjusted market index, deep learning

E-mail: sachinthadilshan96@gmail.com

601/E2

Metal ion complexation-based detection system for the identification of indoor cigarette smoke using nicotine as the identifier

W.M.D.A. Wasalamudali and K.R.R. Mahanama*

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

Cigarette smoke is one of the major health concerns worldwide due to its effects on the health of both active smokers and passive smokers. Harmful chemicals such as nicotine, carbon monoxide, hydrogen cyanide, nitric oxide, and N-nitrosamines, which are found in cigarette smoke can have a detrimental effect on the behavioural and socio-economical aspects of smokers as well. Thus, the presence of a detection system for the identification of cigarette smoke is of utmost importance; especially, in domestic settings as cigarette smoke is one of the main indoor pollutants. This research primarily focuses on the development of a simple, reliable, and sensitive detection system for monitoring cigarette smoke in a domestic setting. Nicotine was chosen as the indicator for the system due to its high abundance in cigarette smoke along with its absence in the environment under normal circumstances. Several approaches such as fluorescence, complexation and oxidation were considered to identify possible lead compounds for the detection system. The complexation of nicotine with metal ions was possible owing to the ability of nicotine to act as either a monodentate or a bidentate ligand. Several candidates were found through the complexation approach, which were subsequently subjected to further UV-visible spectroscopic analysis. Two lead compounds containing the metal ions, Ba(II) and Cu(II), were identified due to the presence of a clear correlation between the nicotine concentration and the amount of complex formed with both these ions. During the analysis, Cu(II) gave a visible colour change following the complexation, while Ba(II) failed to do so. Evidence also showed the affinity of Cu(II) towards nicotine to be much higher than that of Ba(II), even though further confirmatory tests are required. However, when the nicotine levels are lower than 50 ppm, the colour change of a Cu(II) solution is almost imperceptible. In future work, these lead compounds could be developed into a nicotine sensory device for the environmental detection of nicotine.

Keywords: Nicotine, cigarette smoke, complexation, detection

E-mail: maha@chem.cmb.ac.lk

602/E2

A pilot study on heavy metal concentrations in biotic and abiotic elements in rice paddies

I.M.A.K. Karunasena[1], M.R. Wijesinghe[2], R.D. Wijesekera[1], and S.M. Vithanarachchi[1]*

[1] Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka
[2] Department of Zoology & Environment Sciences, University of Colombo, Sri Lanka

Heavy metal pollution is a serious problem in the world today. Some of the main anthropogenic activities linked to this is the extensive use of chemical fertilizers in agriculture. This study was conducted to determine heavy metal levels in several biotic and abiotic components within rice paddies in Sri Lanka. Samples of water, soil, water spinach leaves (*Ipomea aquatica*), shells of the golden apple snail (*Pomacea diffusa)* and feathers of the Asian Openbill *(Anastomus oscitans*) were collected during September–December in 2021. Samples were collected from five different paddy cultivated areas in the Kurunegala district. Samples were digested following standard procedures outlined in American Society for Testing Materials (ASTM). Three heavy metal levels (Zn, Cd and Pb) were analyzed using atomic absorption spectroscopic (AAS) technique. Cadmium was below the detection limit (0.01 ppm) in biotic and abiotic samples. The maximum Pb and Zn concentrations were observed in soil and water spinach, respectively. Mean Pb (7.07 ± 0.20 mg/kg) and Zn (2.13 ± 0.10 mg/kg) concentrations in soil were below the permissive limits recommended by world health organization (WHO) for soil. The mean Pb (5.33 ± 0.16 mg/kg) and Zn (197.20 ± 9.15 mg/kg) concentrations in water spinach were above the permissive limits recommended by WHO for water spinach. The results imply that water spinach growing in these paddy fields are not suitable for human consumption. Bioconcentration factors of Zn and Pb in biota varied with a common pattern being evident —water spinach > Openbill > snail. Biomagnification factors for Zn and Pb for water spinach/snails were less than 1 whereas for snails/openbill it was greater than 1. Overall, findings of this study suggest that levels of the toxic metal Pb and the essential metal Zn has the potential to reach toxic limits. Hence, reducing the levels of fertilizer use, which is the primary source of these metals would be an important step towards safeguarding the biotic communities in these semi natural landscapes.

Keywords: Heavy metals, biotic, abiotic, atomic absorption spectroscopy, paddy fields

E-mail: sashimv@chem.cmb.ac.lk

603/E2

Use of CadC protein of *Bacillus* species isolated from industrial effluents for biosensor construction

T.V.G. Lirushie, D.M.D.C. Dissanayaka, and C.D. Wijayarathna*

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

Heavy metal pollution is currently a source of great concern owing to its adverse effects on organisms and ecosystems. The use of bioremediation-based techniques for heavy metal detection and removal has gained popularity with the increasing knowledge on microbial metal resistance mechanisms and related genetic determinants. In this study, the Pcad promoter and $cadC$ regulatory gene of the chromosomal $cadAC$ operon of *Bacillus megaterium* TWSL_4 (NBRC 114811), which showed resistance towards potentially toxic elements (Cd, Pb, Cu) was used to construct a whole-cell biosensor. The target region of the operon was amplified, and the resultant insert of 710 bp was inserted to pQBIT7-GFP plasmid. Ligated mixture was subsequently transformed into *Escherichia coli* BL21(DE3) and the recombinant transformants were confirmed as the expected whole-cell biosensor (pCGF) through a colony PCR. Afterwards, the functionality of the biosensor was analysed. The metal tolerance analysis of the recombinant strain grown in 100 ppm Pb(II), Zn(II) and Cd(II) spiked broths, showed a significant ($p<0.05$), moderate and no resistance, respectively. The host strain showed no resistance for all three metal ions tested. Apart from the growth of the pCGF strain being significant and resembling the standard growth curve in Pb spiked medium, it showed a colour change from pale yellow to black-brown with time. This suggested that the recombinant strain possesses a Pb resistance mechanism, which led to the precipitation of Pb(II) ions extracellularly, possibly as its oxide. Hence, the resultant recombinants have a potential of being developed as a bioremediation tool for Pb(II) ion removal or detection. The biosensor constructed in this study was aimed to be used in qualitative and quantitative analysis of heavy metals in wastewater by measuring the expression of GFP. Future work includes the experimental determination of GFP expression of the biosensor.

Keywords: Heavy metals, *Bacillus megaterium,* whole-cell biosensor, Pb(II)

E-mail: dilruksh@chem.cmb.ac.lk

604/E2

Isolation and characterization of secondary metabolites of *Monascus* fungi from selected rice varieties in Sri Lanka

R.P.T. Madushani, I. wanninayaka, M.N. Kaumal, and C.M. Hettiarachchi*

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

Monascus fermented products including red mold rice have been used in South Asian countries since pre-historic times due to their numerous benefits. Secondary metabolites such as *Monascus* pigment, monacolin K, citrinin, gamma amino butyric acid, *etc.* produced by the fungus during the fermentation have brought out many advantages. Due to the contribution of red mold rice in the prevention of chronic illnesses, isolation, characterization, and investigation of new *Monascus* species have become important. The aim of this study was to isolate *Monascus* species from selected rice varieties of Sri Lanka. Samples from four rice varieties; namely, Suwadel, Kaluheenati, Madathawalu, and Sudu Kekulu were washed, soaked overnight, and incubated for two weeks at room temperature. In addition to differently colored colonies, fungi similar in color to *Monascus* (red and pink) were identified from all four varieties. Those fungi were isolated and the morphological and microscopic characteristics were studied, followed by the analysis of secondary metabolites, which are produced by the fungus during the fermentation. The availability of red, yellow and orange pigments, citrinin, and Monacolin K were checked by measuring absorbance at 500 nm, 400 nm, 470 nm, 330 nm and 238 nm, respectively. The isolated fungal extracts have shown maximum absorbance at 503 nm, 417 nm, 466 nm and 340 nm. A TLC assay was carried out to separate pigments with different colors and to determine their R_f values. The TLC showed the separation of yellow and orange pigments with R_f values of 0.622 and 0.406, respectively. An antibacterial susceptibility assay and an antioxidant assay were performed to test the biological characteristics of the isolated fungal extracts. Extracts exhibited antibacterial activity against both *Escherichia coli* and *Streptococcus aureus,* and around 67% of antioxidant activity. In comparison to literature data, biochemical, microscopic and macroscopic features of tested fungi have exhibited similarities to *Monascus* spp., and these results indicate that there could be a closer relationship between the isolated fungi and *Monascus*.

Keywords: *Monascus*, secondary metabolites, fungal extract, pigment, citrinin

E-mail: chamarih@chem.cmb.ac.lk

605/E2

Advancement of a super hydrophobic solution with antibacterial properties

M.O. Chamika, V.U. Godakanda, K.M.N. de Silva* and W.R.M. de Silva

Centre for Advanced Materials and Devices (CAMD)
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

Over the past two years, the coronavirus disease (COVID-19) has led to a dramatic loss of human life worldwide. As a result, many new personnel protective equipment (PPE) has been introduced, among which, face masks have garnered the most attention. Therefore, our study focuses on the development of a superhydrophobic (SHPB) solution spray that can be applied to fabrics and used as a face mask in a convenient manner. On this behalf, ZnO nanoparticles (Nps) were synthesized by a simple precipitation method, and hexadecyltrimethoxysilane (HDTMS) was used for the chemical modification of the ZnO Nps. A minor amount of epoxy resin was also used. This solution was then sprayed onto cotton fabrics to develop the final superhydrophobic fabric. The contact angle of the treated cotton was 148°. Scanning electron microscopy (SEM) and X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and UV spectroscopy were used to characterize both ZnO Nps and developed cotton fabrics. The antibacterial activity of the developed superhydrophobic cotton fabrics was tested against Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli* bacteria using a disc diffusion assay. In addition, a separate antibacterial assay for the SHPB solution was also carried out using the micro broth dilution method. The minimum inhibitory concentration of the developed SHPB solution was found to be 45 mg/mL against *Escherichia coli* and 50 mg/mL against *Staphylococcus aureus.* The disc diffusion assay for the treated fabrics indicated an inhibitory diameter of 2 mm for *S. aureus* and inhibitory diameter of 4 mm for *E.coli*. Hence, our developed SHPB cotton fabric is a good source for developing face masks to protect people from respiratory infectious diseases.

Keywords: Super hydrophobic, cotton fabric, ZnO nanoparticles, antibacterial

E-mail: kmnd@chem.cmb.ac.lk

606/E2

Plant extract-based synthesis of zinc oxide nanoparticles and investigation of its effect on mosquito larvae

M.G.C. Chathurangi, P.V.D.G.N. Silva and S.M. Vithanarachchi

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

Vector-borne diseases are reported as more than 17% of communicable diseases and cause over 700,000 deaths annually worldwide. One of the most dangerous vectors is mosquitoes. They mainly transmit malaria, filariasis, dengue, Japanese encephalitis, chikungunya, and the zika virus. Larviciding is one of the best methods to reduce mosquito-borne diseases by regulating the mosquito population in their larvae stages. Currently, chemical insecticides and organophosphates are used as larvicidal agents with adverse effects on humans and other non-target animals. This study focused on the synthesis of plant extract-based zinc oxide nanoparticles (ZnO-NPs) using extracts of *Carica papaya* (papaya) and investigate its larvicidal activity against mosquito larvae. In this study, the co-precipitation method was used to synthesize ZnO-NPs. One set of ZnO nanoparticles was synthesized using plant extracts and another set of ZnO nanoparticles was synthesized without plant extracts (Chem-ZnO NPs). Synthesized particles were characterized using UV-vis spectroscopy, FTIR spectroscopy, and scanning electron microscopy (SEM). According to the SEM analysis, papaya fresh seed extract based-ZnO NPs (PFS-ZnO) showed particles ranging from 80–180 nm while Chem-ZnO NPs showed particles ranging from 40–105 nm. According to the findings of this research, both Chem-ZnO NPs and PFS-ZnO NPs showed larvicidal activity against mosquito larvae. The mortality values for Chem-ZnO NPs at 100 ppm, 200 ppm, 500 ppm, and 1000 ppm for 24 h and 48 h were 0%. However, the 1000 ppm solution of Chem-ZnO NPs showed a 20% mortality value after 72 h. The resulted percentage mortality values of PFS-ZnO NPs after 24 h were 3% (100 ppm) and 7% (for 200 ppm, 500 ppm, and 1000 ppm). The obtained mortality percentages of PFS-ZnO NPs after 48 h were 7% (100 ppm), 10% (200 ppm), 17 % (500 ppm), and 23% (1000 ppm). Further, after 72 h, the mortality percentages of PFS-ZnO-NPs found to be 17% (100 ppm), 33% (200 ppm), 27% (500 ppm), and 37% (1000 ppm). The positive control (malathion) showed 0% (100 ppm), 20% (200 ppm, 500 ppm), and 30% (1000 ppm) mortality only after 72 h. These results indicate that the incorporation of plant extracts in the synthesis of ZnO NPs has enhanced the larvicidal activity of ZnO NPs due to the phytochemicals present in the plant extract. According to the overall results of this study, papaya seed extract-based ZnO nanoparticles can be modified as an eco-friendly alternative larvicidal agent in place of currently using chemical insecticides.

Keywords: *Carica papaya,* zinc oxide, nanoparticles, mosquito larvae

E-mail: sashimv@chem.cmb.ac.lk

607/E2

Plant extract-based synthesis of zinc oxide and iron oxide nanoparticles and investigation of their antioxidant and anti-diabetic properties

D.S. Weerahannedige, P.V.D.G.N. Silva and S.M. Vithanarachchi

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

Nanotechnology may have a paradigm-shifting influence on basic research, drug development, and clinical medicine. Plant extract-based synthesis of metal-oxide nanoparticles is an emerging alternative to conventional synthetic methods and allows the incorporation of various properties possessed by phytochemicals into nanoparticles. Plant-derived nanomaterials have numerous applications in biological fields due to their ability to interact with complex biological processes at the scale of biomolecules, making them good candidates in the treatment of various diseases. Type II diabetes mellitus is such a disease that lacks economical therapies even today, and alternative medicines are constantly sought after. The purpose of this study is to synthesize zinc oxide and iron oxide nanoparticles mediated with *Ixora coccinea* (Rathmal, flowers) and *Gymnema sylvestre* (Mas-bedda, leaves) extracts by co-precipitation method and investigate their *in-vitro* antioxidant and antidiabetic activity. Nanoparticles were characterized by UV-visible, FTIR spectroscopic methods, and scanning electron microscopy. The results show that incorporation of phytochemicals allows metal-oxide nanoparticles to acquire novel properties. DPPH free radical scavenging assay conducted for zinc oxide nanoparticles shows that plant extract-derived nanoparticles have a significantly greater antioxidant capacity compared to chemically synthesized nanoparticles at 95% confidence level. This study further reveals that Ixora ethanol extract-based nanoparticles exhibit enhanced antioxidant properties with percent radical scavenging activity (RSA%) up to 65.8% following 24-hour incubation time. The results obtained by the study show that the neat plant extracts are not stable under the ambient conditions and the activity shown by the extracts decreases with time. However, plant extract-incorporated particles were stable over 3-4 months and showed consistent activity. Hence, plant extract-mediated synthesis permits to overcome the instability of plant extracts. Antidiabetic activity of synthesized particles was assessed by alpha-amylase inhibition assay. Mas-bedda water extract-based zinc oxide nanoparticles have shown better antidiabetic properties compared to chemically synthesized nanoparticles. However, the results given by iron oxide nanoparticles for both assays are not sufficient to draw any conclusion and requires further studies. Findings of this study reveal that incorporation of plant extracts has enhanced the antioxidant and anti-diabetic properties of bare zinc oxide particles, implying the potential applications of plant extract-based nanoparticles in developing successful drug-delivery systems.

Keywords: Nanoparticles, plant extract, anti-diabetes, antioxidant

E-mail: sashimv@chem.cmb.ac.lk

608/E2

Graphene oxide incorporated electrospun nanofibers for water purification

A.G.I.D. Abeywickrama, K.M.N. de Silva, W.R.M. de Silva*, M.S. Fernando and
V.U. Godakanda

*Centre for Advanced Materials and Devices (CAMD),
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka*

With the development of nanotechnology, the fabrication of electrospun nanofibers has drawn increasing attention due to their significant specific surface area, outstanding functional properties, and high porosity. In this study, a novel electrospun nanofiber was fabricated and tested for the adsorption of heavy metals and fluorides. Graphene oxide (GO) has already got the attention of scientific community due to its surprising properties. The major objective of this study was to develop a GO incorporated electrospun fiber mat with improved adsorption properties. For this purpose, graphene oxide as a filler was incorporated into polyvinyl alcohol/ethyl cellulose/polyvinylpyrrolidone (PVA/EC/PVP) and electrospun to fabricate the novel PVA/EC/PVP/GO composite fiber mat. Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), X-ray diffraction (XRD), and scanning electron microscopy (SEM) analyses were used to characterize the electrospun PVA/EC/PVP/GO novel fiber mat. Adsorption studies of Pb^{2+}, Cd^{2+}, and F^- ions were conducted using neat and composite fiber mats. FTIR spectra exhibited characteristic bands at 3550–3200cm^{-1} for PVA, 1052cm^{-1} for EC, 1652cm^{-1} and 1286cm^{-1} for PVP confirming the presence of all polymers. The impact of variables such as contact time, pH, and initial concentration on the removal of Pb^{2+}, Cd^{2+} and F^- were also studied. The results of the batch adsorption studies of neat and composite fiber mats were fitted into both Langmuir and Freundlich adsorption isotherm models. The experimental data fitted better with the Langmuir isotherm model. The maximum adsorption capacities for Pb^{2+} and Cd^{2+} for the neat mat were 28.98 mg/g and 13.68 mg/g, respectively. Adsorption was improved for the composite, with 192.31 mg/g, 59.88 mg/g, and 42.73 mg/g adsorption capacities for Pb^{2+}, Cd^{2+} and F^-, respectively. The results of the study indicated that the incorporation of GO into PVA/EC/PVP can form a nanofibrous mat with enhanced adsorption capacities towards Pb^{2+}, Cd^{2+}, F^- ions. Thus, it can be identified as an adsorbent with versatile adsorption properties and shows great potential in real water purification applications.

Keywords: Adsorption, composite, electrospun, graphene oxide

E-mail: rohini@chem.cmb.ac.lk

609/E2

Lactobacillus reuteri incorporated electrospun PEO/ sodium alginate polymeric nanofibers as probiotic nutraceuticals

W.M. Chathurani, V.U. Godakanda, W.R.M. de Silva and K.M.N. de Silva*

Centre for Advanced Materials and Devices (CAMD),
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

Probiotics are beneficial microorganisms due to various health benefits to the host. Probiotics are used for treatment of various disease conditions such as diarrheal conditions, inflammatory bowel disease, functional constipation in adults, and for reduction of total cholesterol levels. Currently, they are used as nutraceuticals to boost the healthy life. Even though there are many probiotics incorporated in non-conventional food products and conventional pharmaceutical products available in the market, the amount of viable probiotic cells in those preparations are problematic at the time of consumption. Therefore, it is paramount to develop successful technologies to protect the viability of the probiotic cells within the preparations. The electrospinning technique is recently emerged as an efficacious method of encapsulating probiotic cells in nanofibers. This study was carried out to produce the probiotic encapsulated pharmaceutical and other products for enhancing the viability of probiotic cells. Hence, here it was focused on the production of probiotic-loaded (*Lactobacillus reuteri*) nonwoven nanofibers for oral consumption by using only polyethylene oxide (PEO 1000 kDa) and the sodium alginate blend as the polymer coating. Both these polymers have excellent biocompatibility and biodegradability and are therefore non-toxic to human or probiotic cells. For this development, the stability of nanofibers was optimized using PEO and sodium alginate in deionized water and finally with probiotic-loaded polymer blend. Synthesized nonwoven blank and probiotic loaded nanofiber mats were characterized by optical microscopy, Fourier transform infrared spectroscopy, and scanning electron microscopy (SEM). The SEM images showed successful encapsulation of the probiotic cells within the nanofibers. The viability studies were carried out for the probiotic loaded polymer solution before spinning, and probiotic loaded nanofiber mat by using the drop plate method. The number of viable cells were reduced from 1.75×10^8 to 4.44×10^6 just after the spinning and probiotic loaded fiber mat had viable amount of bacteria that can give effective health benefits over 14 days after spinning of 1 mL of the solution for about 3 hours.

Keywords: Electrospun, probiotics, nutraceuticals, nanofibers

E-mail: kmnd@chem.cmb.ac.lk

610/E2

Development of graphene oxide-based polymer nanocomposite for water purification

M. K. Gunawardana, H. N. Disanayaka, M. S. Fernando, W. R. M. de Silva and
K. M. N. de Silva*

*Centre for Advanced Materials and Devices (CAMD),
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka*

The accumulation of toxic metals and anions in water has been a major problem over the world including Sri Lanka. This work is focused on developing a graphene oxide-based nanocomposite as an effective adsorbent to remove Pb^{2+}, Cd^{2+}, and F^- in water. Polypyrrole (PPy) was used as the polymer due to its non-toxicity and interesting chelating properties. Graphene oxide (GO) was synthesized using a modified Hummer's method and the pyrrole was oxidized and polymerized to synthesize graphene oxide/polypyrrole (GO/PPy) nanocomposites with different ratios, 10:90, 15:85, and 20:80. From the initial adsorption studies, the best composite (20:80) was identified and characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), UV-visible and Raman spectroscopies. Crystallinity, morphology, functional groups, and thermal properties were identified with these analyses. Batch adsorption studies were conducted for Pb^{2+} and Cd^{2+} and F^- ions to investigate their adsorption properties. For Pb^{2+} and Cd^{2+}, the optimum contact time was 30 min and 40 min, respectively, while the optimum pH for both metal ions was pH 7. According to the adsorption data, the Langmuir adsorption isotherm was identified as the best-fitted model for Pb^{2+} with calculated monolayer adsorption capacity (Q_o) of 8.50 mg g^{-1} while Freundlich adsorption isotherm was the best-fitted model for Cd^{2+} with 7.48 mg g^{-1} calculated adsorption capacity (Q_e). The optimum contact time for the F^- adsorption was found to be 60 min at pH 7. Adsorption data was well fitted with Langmuir adsorption isotherm and calculated Q_o value was 5.27 mg g^{-1}. Thus, GO/PPy nanocomposite can be identified as an efficient adsorbent to remove different types of contaminants from water.

E-mail: kmnd@chem.cmb.ac.lk

611/E2

Synthesis of graphene and quantum dots from graphite using modified electrochemical exfoliation method

H.N. Disanayaka, M.K. Gunawardana, M.S. Fernando, K.M.N. de Silva
and W.R.M. de Silva*

*Centre for Advanced Materials and Devices (CAMD),
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka*

Sri Lanka is the only country having vein graphite as a natural mineral. It would be advantageous if graphite can be converted into high-quality graphene *via* facile methods. This work aimed to develop an electrochemical exfoliation method to convert graphite into graphene as it is a promising cost-effective and eco-friendly method. For this purpose, graphene was synthesized by electrochemical exfoliation using the platinum electrode as the anode and a graphite flake as the cathode with different types of surfactants. Sodium dodecyl sulfate (SDS) was used as the anionic surfactant, while cetrimonium bromide (CTAB) and Triton X-100 were used as the cationic surfactant and the non-ionic surfactant, respectively. Out of three surfactants, SDS showed complete exfoliation and resulted in thin, rolled-up graphene sheets with high stability and solubility. Voltage, time of exfoliation, and the concentration of the surfactants were optimized. In addition to that, a novel method was developed to synthesize blue-emitting quantum dots (bQDs) using the best form of graphene sheets resulting from SDS. These graphene sheets were heated with *L*-ascorbic acid and the resultant solution was centrifuged and purified using a cellulose dialysis membrane to obtain bQDs. The highest quantum yield was 0.69 with an emission wavelength of 432 nm at the excitation wavelength of 345 nm. To the best of our knowledge, this is the first time that bQDs have been synthesized using electrochemically exfoliated SDS-mediated graphene. This is a simple and easy way of synthesizing both graphene and graphene quantum dots without using hazardous chemicals or costly methods. It was possible to incorporate bQDs into crosslinked carboxymethyl cellulose (CMC) polymer without interrupting their fluorescence behavior. The best form of graphene and bQD were characterized using UV-visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, scanning electron microscopy (SEM), and X-ray diffraction (XRD) to confirm the successful synthesis and to investigate their functional, morphological, and structural properties. Results indicate that the electrochemical exfoliation of Bogala vein graphite was a facile method to produce graphene as well as graphene quantum dots, which can be applied to many other applications.

Keywords: Graphite, graphene, quantum dot, exfoliation, fluorescence

E-mail: rohini@chem.cmb.ac.lk

612/E2

Molecular docking and simulation studies to investigate how bergenin as a flavonoid molecule binds to cyclin-dependent kinase-2 (CDK2) in antitumor treatments

P.T. Thusharika and Samantha Weerasinghe*

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

In traditional medicine, many plants in Sri Lanka have been used to treat cancer. One of the target proteins in cancer treatment is cyclin-dependent kinase-2 (CDK2). CDK2 proteins work on S/G2 checkpoint and G1/S checkpoint. CDK2 is a positive regulator in the cell cycle. When a positive regulator overexpresses, it can speed up the cell cycle, causing cell proliferation and making it more challenging to manage. This process triggers cancers. Inhibiting CDK2 can cause cancer cells to die. Flavonoid-type molecules are considered as possible drug candidates to bind to CDK2 protein. In Sri Lanka, most ayurvedic doctors use *Fluggea leucopyrus* Willd (Katupila) plant leaves to treat cancers. Previous studies have found that this plant leaf has a compound known as bergenin. Bergenin is a C-glucoside of 4-O-methyl gallic acid. In this research, bergenin was tested as a possible drug candidate for cancer using molecular docking and molecular dynamics methods. The results indicate the stability of the protein-ligand complex. 3,5,7,3',5'-pentahydroxy-flavanonol-3-O-α-L-rhamnopyranoside from *Bauhinia strychnifolia* Craib and rohitukine from *Dysoxylum binectariferum* were used as two reference compounds. Their molecular docking and molecular dynamic results were compared with the bergenin results. After flexible docking, bergenin and two reference compounds were found in nearly the same location in the CDK2 protein. Using those flexible docking structures, molecular dynamic simulations were carried out for all three protein-ligand complexes. From the molecular dynamics simulation results, it was found that residues, Glu12 and Lys33 were common in making hydrogen bonds with all three ligands. Molecular docking and molecular dynamics simulation results proved that the bergenin ligand behaves like the other two reference molecules and is firmly bound to the binding pocket of CDK2 protein within the 25 ns time period. Furthermore, the bergenin and CDK2 complex show strong hydrogen bonds. Bergenin was surrounded from all sides by hydrogen bonds. The above information confirms that bergenin binds well with the CDK2 binding pocket, and it can be concluded that bergenin found from the Katupila plant could be a lead compound that should directed for laboratory testing to study its activity to bind to CDK2 protein and to inhibit cancer cells.

Keywords: Molecular docking, molecular dynamics, anti-cancer drug, Bergenin

E-mail*: weera@chem.cmb.ac.lk

613/E2

Investigation of the antibacterial and anticancer properties of the *B. vulgaris* var. *vittata* (golden bamboo) juice

S. Jeyaludsumy, N.I. Abeyasinghe and G.N. Silva[*]

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

Resistance to current antimicrobial and anticancer agents has endangered lives and challenged the advancements in modern health care, emphasizing the urgent need to address this problem with innovative solutions. Also, the current cancer treatments show adverse effects on normal cells and show low efficacy against certain cancers. Due to these limited applications of the current antibacterial/anticancer agents, there is a growing demand to screen for novel bioactive compounds present in medicinal plants, which can be potential new medicines. *Bambusa vulgaris* (common bamboo) is used to treat various ailments from ancient times. In this study, the shoot of *B. vulgaris* var. *vittata* (golden bamboo) is chosen to evaluate its antimicrobial and antiproliferative properties on selected bacteria and cancer cell lines, respectively. The antimicrobial activity of autoclaved and filtered bamboo shoot juice (without water) were evaluated against Gram-positive bacteria (*S. aureus, B. subtilis, E. faecalis*), and Gram-negative bacteria (*E. coli, P. aeruginosa, P. vulgaris*) using MTT assay. Since the autoclaved plant juice has shown a higher antibacterial activity over the filtered juice, the time-dependent inhibition assay was conducted (1.5 h, 2.5 h and 3.5 h incubation) to quantify the antibacterial effect of autoclaved juice. Our results indicate that all the tested bacteria have a similar susceptibility to the autoclaved extract resulting in an IC_{50} of 35-45% extract (v/v). Dried powder of the filtered bamboo shoot juice was also found to have a strong antiproliferative effect on MCF-7 breast cancer cell lines and shows a dose-dependent antiproliferative activity with an IC_{50} of 33.6 μg/ml. Therefore, it can be concluded that the *B. vulgaris* (variety *vittata*) shoot extract has both antimicrobial and anticancer properties, which support its use as a remedy for bacterial infections and cancers.

Keywords: *Bambusa vulgaris*, antimicrobial, antiproliferative, cancer, MCF-7, MTT assay

E-mail*: gayathris@chem.cmb.ac.lk

614/E2

Isolation of endophytic fungi from *Wendlandia bicuspidata* (Rawana idala) and determination of its antibacterial properties

D.J.N. Senevirathna and C.M. Hettiarachchi*

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

Over the past few decades, there has been a significant increment of diseases caused by microorganisms. The development of drug-resistant microbes forced the researchers to find new antimicrobial agents. This led to the discovery of a new field of study called metabolomics, which involved screening plants and other living things to find bioactive compounds. Although Sri Lanka is a hotspot for biodiversity, less research has been carried out on studying endophytic fungi metabolites. Hence, this study was focused on the isolation and identification of potential antimicrobial substances from endophytic fungi isolated from *Wendlandia bicuspidata*. During this process, surface sterilized leaf parts of *W. bicuspidata* was incubated on potato dextrose agar plates for ten days at room temperature. Three different fungal strains were isolated and each of them were separately cultured on sabouraud dextrose broth. Based on the colour of the fungal biomass, these were named as Black, White, and Brown. After two weeks of fermentation, culture media were extracted into an ethyl acetate phase. Crude extracts of each fungal strain were concentrated under reduced pressure and their dry weight was measured. The crude was dissolved in ethyl acetate (30 mg/mL) and disk diffusion and broth microdilution assays were conducted against four bacterial strains: *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Bacillus subtilis*. Among the three fungal crude extracts, the 'Black' fungal extracts showed the highest activity against the tested bacteria. The highest antibacterial activity was observed against Gram-positive bacteria *S. aureus*, with 11.25 ± 1.50 mm diameter inhibition zone. Minimum inhibitory concentration (MIC) was measured using microdilution method for the bacteria: *S. aureus*, *B. subtilis* and, *E. coli* as ≥ 10.0 mg/mL, ≥ 15.0 mg/mL, 17.5 mg/mL, respectively. These results confirmed the 'Black' fungus from *W. bicuspidata* could be a potential source of antibacterial compounds. However, 'Brown' fungus did not show any antibacterial activity and 'White' fungus showed a moderate activity.

Keywords: Endophytic fungi, antibacterial activity, *W. bicuspidata*

E-mail*:* chamarih@chem.cmb.ac.lk

615/E2

A study on testing authenticated Ayurveda herbal formula for antibacterial potential

K.K.N.S. Siriwardhana[1], R.D.H. Kulatunga[2], P. Paranagama[2] and C. M. Hettiarachchi[1]*

[1]Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka
[2] Institute of Indigenous Medicine, University of Colombo, Rajagiriya, Sri Lanka

The development of resistance in bacterial strains against current antibacterial drugs is a crucial problem worldwide. At present, many researchers have started investigating the antibacterial properties of traditional medicine. This research was conducted to evaluate the potential antibacterial activity of Ayurveda herbal formulation ('Yakshakshyadi kasaya') and to determine the minimum inhibitory concentration of Ayurveda herbal formulation against six bacterial strains: Gram-positive; *Enterococcus feacalis*, *Bacillus subtilis*, *Staphylococcus aureus*, and Gram-negative; *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Escherichia coli*. The antibacterial potential of the Ayurveda herbal formulation was tested using the disk diffusion assay. The disk diffusion assay was performed for 100, 50, 25 and 12.5 mg/mL concentrations and the diameter of the inhibition zones were measured. Interestingly, all bacterial strains tested were susceptible to Ayurveda herbal formula showing its broad-spectrum antibacterial properties. Among them, *B. subtilis* showed a significant inhibition zone for all concentrations giving a 26 ± 1.0 mm highest diameter for the 100 mg/mL concentration. However, *P. aeruginosa* showed a poor result with a fuzzy inhibition zone of 13 ± 1.0 mm for the concentration of 100 mg/mL. The other four bacterial strains showed a moderate activity. The minimum inhibitory concentration (MIC) of Ayurveda herbal formulation was determined using a broth microdilution assay for 80, 70, 60, 50, 40, 30, 20 and 10 mg/mL concentrations. The results showed an 80 mg/mL MIC value for *B. subtilis*, > 80 mg/mL MIC value for *P. aeruginosa*, *E. faecalis*, *P. vulgaris* and *S. aureus,* and ≥ 80 mg/mL MIC value for *E. coli*. According to our knowledge, this is the first report of testing this Ayurveda herbal formula for its antibacterial activity and our results confirmed that it has a broad-spectrum of antibacterial activity.

Keywords: Antibacterial activity, ayurveda herbal formulation, traditional medicine

E-mail*:* chamarih@chem.cmb.ac.lk

616/E2

Biopolymer-based Metatitanic acid composites for water purification

N.G.A.A. Lakmal, M.S. Fernando, K.M.N. de Silva and W.R.M. de Silva*

Centre for Advanced Materials and Devices (CAMD)
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

There is great potential to synthesize many titanium-based value-added products using the minerals of the Pulmoddai Ilmenite mineral ore in Sri Lanka. Metatitanic acid (MTA) is one such product. The major objective of this work was to investigate the ability to use MTA for water purification. Since the powdered form of neat MTA was not user-friendly for the aforementioned application, it was modified into a thin film composite by incorporating it into crosslinked carboxymethyl cellulose (MTA:CMC). The composites and neat materials were characterized using X-ray diffraction, Fourier transform infrared spectroscopy, Raman spectroscopy, scanning electron microscopy, thermogravimetric analysis, and UV-visible spectroscopy. The point of zero charge (pzc) was determined as 4.7 for MTA:CMC. The applicability of MTA:CMC membranes in water purification was investigated using Cd^{2+}, Pb^{2+} and F^- ions as the target contaminants. Initial and final concentrations of Cd^{2+} and Pb^{2+} were measured using atomic absorption spectrophotometer and F^- ion concentrations were measured using fluoride ion-selective electrode. MTA:CMC composite showed good adsorption properties towards Cd^{2+}, Pb^{2+} and F^- ions. The effect of contact time and pH on adsorption was determined using initial concentrations of 6 ppm of Cd^{2+} and 10 ppm of Pb^{2+} and 10 ppm of F^-, respectively. The optimal pH for Cd^{2+} and Pb^{2+} adsorption was 7.0 and the optimal pH for F^- adsorption was around 2.0–4.0. The optimal contact time for Cd^{2+} was 40 minutes and the optimal contact time for Pb^{2+} and F^- adsorption was 50 minutes. The results of the batch adsorption studies were fitted into both Langmuir and Freundlich adsorption isotherm models. It was observed that all three ions follow the Freundlich adsorption isotherm model with a higher coefficient of determination R^2. Calculated adsorption capacities (Q_e) for Cd^{2+}, Pb^{2+} and F^- were 4.12 mg g^{-1}, 4.85 mg g^{-1} and 7.14 mg g^{-1}, respectively. The effect of other ions on adsorption indicated that Mg^{2+} and Ca^{2+} competitively decrease the adsorption of Cd^{2+} and Pb^{2+} on MTA:CMC.

Keywords: Metatitanic acid, carboxymethyl cellulose, composite, water purification

E-mail: rohini@chem.cmb.ac.lk

617/E2

Development of novel antibacterial food packaging films

H.D.C. Nadeesha, K.M. Nalin de Silva and W.R.M. de Silva*

Centre for Advanced Materials and Devices (CAMD)
Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

The extensive use of petroleum-based plastic food packaging, which gives rise to serious ecological problems, and the wastage of food due to spoilage has led to inreased attention towards the development of active food packaging from biodegradable polymers. Therefore, this study was designed to develop a novel pectin and carboxymethylcellulose (CMC) based film incorporated with silver nanoparticles (Ag NPs), which could be utilized as a potential food packaging film with antibacterial properties. Ag NPs were synthesized by a chemical reduction using tri-sodium citrate as the reducing and stabilizing agent. Pectin and CMC were used in a 1:1 ratio in the film fabrication process and Ag NPS were incorporated into Pectin/CMC polymer matrix in different volumes to have different blend ratios. Fabrication of films was carried out using the solvent casting technique where citric acid was utilized as the cross-linking agent and glycerol as the plasticizer. Prepared films were evaluated using tensile strength (TS), percent elongation at break measurements (EAB), water vapor permeability measures (WVP), spectroscopic studies, water solubility tests, scanning electron microscope (SEM) studies, thermal gravimetric analyses, and antibacterial studies. FTIR spectrum, UV-visible spectrum, and SEM images of the formulated films confirmed the incorporation of Ag NPs into the pectin/CMC polymer matrix. TS values of films varied from 10.43–15.73 MPa where the incorporation of Ag NPs slightly increased the TS of films. The film with the highest Ag NPs content showed a maximum decomposition temperature at 267.74 °C, which indicates that this polymer matrix has adequate thermal stability to use in food packaging. Moreover, the addition of Ag NPs decreased the WVP and water solubility of films suggesting that Ag NPs could enhance the mechanical and water moisture barrier properties of pectin/CMC films. Pectin/CMC films blended with Ag NPs demonstrated good antibacterial activity against *S. aureus* and *E. coli*. Moreover, the films with Ag NPs had antifungal properties under 100% relative humidity conditions. These results conclude that the fabricated pectin/CMC/Ag NPs films have the potential to act as a better substitution for non-biodegradable food packaging materials.

Keywords: Biodegradable, pectin, carboxymethyl cellulose, silver nanoparticles, antibacterial

E-mail: rohini@chem.cmb.ac.lk

618/E2

HPLC method development for the analysis of amino acids in animal feed samples using o-phthalaldehyde (OPA) and 9-fluronylmethyl-chloroformate (9-FMOC-Cl)

D.Y. Mallikarachchi[1]*, J.K. Walpita[2], and N.M.S. Sirimuthu[1]

[1] *Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2] *Department of Multidisciplinary Studies, Faculty of Urban and Aquatic Bioresources, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

A simple and novel high-performance liquid chromatographic (HPLC) method is developed for the analysis of amino acids: both primary and secondary amino acids in animal feed samples. The objectives of this study were to achieve a complete separation of amino acids using fluorescence detection to determine the quality of commercially available animal feeds in the market. All the amino acid standards and animal feed samples were pre-column derivatized using OPA and FMOC-Cl and run through a Shim-pack HR-ODS column (150 × 3 mm, 3 μm). All the primary amino acids were derivatized with OPA, and a thiol co-reagent, 3-mercaptopropionic acid (3-MPA), to make OPA derivatives more stable, and all the secondary amino acids were derivatized by FMOC-Cl. In this study, three types of animal feed samples including broiler starter, special broiler chick booster, and coconut poonac provided by CIC Feeds (Ekala, Sri Lanka), were hydrolyzed in 6 N hydrochloric acid for 24 h at 110 °C in an oven and then analyzed by HPLC after pre-column derivatization. Free amino acids added externally to the broiler starter and special broiler chick booster samples were determined with 0.1 mol/L hydrochloric acid without performing an acid hydrolysis step. The reaction conditions and separation conditions were optimized. During acid hydrolysis, tryptophan was destroyed while threonine and serine were partially destroyed. Methionine might have undergone oxidation. Also, asparagine and glutamine were deamidated, resulting in aspartic acid and glutamic acid, respectively. Therefore, the method requires further optimization of the hydrolysis step to enhance the recovery of the amino acids in future work. This method could be characterized by high specificity and wide linearity. A linear range with satisfactory regression coefficients > 0.99 was reported for all the amino acid standards. The limit of detection (LOD) was 0.0018 mg/m^3 to 0.025 mg/m^3, and the limit of quantitation (LOQ) values were in a range of 0.0056 mg/m^3 to 0.078 mg/m^3. According to the results obtained throughout the study, the procedure could be successfully used as a method for the total separation of 16 amino acids in commercial animal feeds.

Keywords: Amino acids, HPLC analysis, FMOC-Cl, OPA, animal feeds

E-mail: as2017151@sci.sjp.ac.lk

619/E2

Evaluation of urease inhibitory activity of *Terminalia catappa* leaf extracts

D.N. Udukala* and S.A.R. Waidyalankara

Institute of Chemistry Ceylon, College of Chemical Sciences, Rajagiriya, Sri Lanka

Helicobacter pylori is a pathogenic bacterium that causes infections in the digestive tract by hydrolysing urea into ammonia and carbon dioxide in the presence of the urease enzyme. Though effective antimicrobial therapies are available, yet there is no perfect treatment, and treatments are continually evolving. The present study investigates the urease inhibitory activity (*in vitro*) of leaf extracts of *Terminalia catappa*. *Terminalia catappa Linn.*, which is native to Southeast Asia, is well known for its nutritional fruit and therapeutic benefits. All parts of the plant are used in traditional medicine and the leaves have been shown important for the protection against acute liver injury and many microbial diseases. The powdered leaf of *Terminalia catappa* was extracted using hexane, ethyl acetate, ethanol and water. The anti-urease activity of the leaf extracts of *Terminalia catappa* was evaluated against, *Canavalia ensiformis* (Jack bean) urease using modified Berthelot's color reaction method. In the evaluation of urease inhibition, thiourea was utilized as the standard urease inhibitor. The standard inhibitor, thiourea, had an IC_{50} value of 0.0028 ± 0.0007 mg/mL. The continuous aqueous extract of *Terminalia catappa* leaves had the lowest IC_{50} value of 0.0333 ± 0.0242 mg/mL, indicating the strongest urease inhibitory activity among the five plant extracts, which was followed by the direct aqueous extract having an IC_{50} of 0.0364 ± 0.0120 mg/mL. Ethanol, ethyl acetate and hexane showed comparatively higher IC_{50} values indicating lesser urease inhibitory potential. Since aqueous extracts of *Terminalia catappa* leaves exhibited highest urease inhibitory activity, future investigations can be conducted on the aqueous extracts of *Terminalia catappa* leaves to evaluate its urease inhibitory potential to be used as a therapy for *Helicobacter pylori* infections.

Keywords: *Terminalia catappa,* anti-urease activity, *Helicobacter pylori,* natural urease inhibitors, plant extracts

E-mail: dinusha@ichemc.edu.lk

620/E2

Evaluation of urease inhibitory activity of *Costus speciosus* leaves

K.U.S. Perera and D.N. Udukala*

Institute of Chemistry Ceylon, College of Chemical Sciences, Rajagiriya, Sri Lanka

Urease is a non-redox nickel containing metalloenzyme produced by *Helicobacter pylori*, a bacterium residing in the gastrointestinal region of the human stomach. It catalyzes the hydrolysis of urea to ammonia and carbon dioxide, making the stomach environment more basic for the persistence of the bacterium in the acidic medium inside the stomach. The prevalence of *Helicobacter pylori* causes gastritis, peptic ulcers, stomach cancers and different gastrointestinal complications. Although many synthetic drugs are currently available for the inhibition of urease produced by *Helicobacter pylori*, it has become controversial due to their toxicity, development of unpredictable side effects and the emergence of antibiotic resistance microbial strains. Hence, this study was focused on evaluating the potential anti-urease activity of compounds present in leaves of *Costus speciosus,* a plant commonly available in Sri Lankan home gardens. Sequential extraction was performed for leaves of *Costus speciosus* by using distilled solvents: hexane, ethyl acetate and ethanol. Among the extracts, the highest extraction yield was obtained for the ethanolic extract as 5.1%. The activity of the enzyme was determined using a colorimetric method; where jack bean urease was used as the enzyme source, and it revealed the enzyme activity as 0.3084 U g^{-1}. In the anti-urease assay the modified Berthelot reaction was used for the development of indophenol blue color, and the absorbance was measured at the wavelength of 630 nm. The IC_{50} value for each extract was determined using the obtained absorbance values. Thiourea was used as the standard inhibitor with an IC_{50} value of 0.0028 (±0.0013) mg/mL. The lowest IC_{50} value 0.0993 (± 0.0001) mg/mL was observed for the ethyl acetate extract of *Costus speciosus* leaves thus, showing the highest urease inhibitory potential compared to hexane and ethanol extracts. Further analysis will be carried out on the ethyl acetate extract to identify the active components responsible for the anti-urease activity.

Keywords*: Helicobacter pylori*, *Costus speciosus,* urease inhibitors, anti-urease activity, thiourea

E-mail: dinusha@ichemc.edu.lk

621/E2

Colon specific drug delivery of diclofenac sodium using Eudragit coated polyvinylpyrrolidone mixed chitosan microparticles

W.R.M. de Silva*, K.M.N. de Silva, U. Godakanda, and I.S. Wickramasinghe

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

Employing drug-loaded nano/microparticles in drug delivery systems show potential for raising local drug concentration, tumor targeting, and improving chemotherapy. The purpose of the present study was to prepare, characterize and evaluate a colon-targeted microspheres with diclofenac sodium (DS), which has potential for anti-inflammatory, analgesic and antipyretic properties. Microparticles were prepared using various polymers to assess their suitability for drug delivery. Among them, microparticles prepared by mixing polyvinylpyrrolidone (PVP) with chitosan (CS), which has not been reported previously in the preparation of DS-loaded microparticles, and tripolyphosphate using the ionotropic-gelation method showed a high drug loading capacity. The microspheres were coated with Eudragit L-100 55 polymer by using the polyelectrolyte complexation technique to prevent drug release in the upper part of the gastrointestinal tract (GIT). Generally, Eudragit polymers dissolve at slightly basic media similar to the colonic environment. The prepared microspheres were tested for surface morphology, functional groups, crystal structures, drug loading efficiency, and *in-vitro* drug release by maintaining different pH environments similar to the GIT. The microspheres had a rough surface as observed by scanning electron microscopy. FTIR and XRD analyses showed a close correspondence between pure compounds and final products that ensure the incorporation of ingredients used in microspheres. The polymer concentration ratio had a direct influence on both the drug loading efficiency and the drug release. The drug loading efficiency of the microspheres showed a decline as the PVP: chitosan (CS) ratio increased. At the same time, the drug release from the microspheres showed a decrease as the PVP polymer concentration increased. The release profile of diclofenac from the Eudragit-coated microspheres was pH dependent and showed different levels of drug release at different pH. It was observed that Eudragit-coated PVP and chitosan mixed microspheres show no release in the acidic pH range, which is similar to the upper part of the GIT, and a tiny release in the intestinal pH range. Most importantly, a significant amount of the drug was released at pH 6.8 similar to the colonic environment. The results indicated that Eudragit-coated chitosan microspheres can be successfully used as a potential tool for colon-targeted drug delivery of diclofenac sodium.

Keywords: Microparticles, chitosan, polyvinylpyrrolidone, ionotropic-gelation

E-mail: rohini@chem.cmb.ac.lk

622/E2

Mathematical modeling of recombinant DNA expression

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

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

Recombinant DNA (rDNA) technology is used for the commercial synthesis of therapeutic biomolecules in microbial cultures. The rDNA molecules engineered for this purpose are promoter-driven and initialized inside the host by utilizing the biochemical resources allocated for gene expression. In this work, a mathematical model for rDNA expression was developed. The model encompasses the mechanics of protein synthesis, promoter manipulation, internal resource pool engagement, and the effect of plasmid loading that are lacking in current models available in the literature. The concentrations of molecular components engaged in protein synthesis are assumed to be within limits to apply continuum hypothesis and mass action-based formalisms. Therefore, by formulating an ordinary differential equation (ODE) for each component, the overall performance of the system under a particular setting can be evaluated. Plugging in the kinetic parameters available in the literature for simulation can be justified because rate constants are not system-specific and can be treated as independent entities. The calculations of the rDNA expression pipeline showed that the maximum reporter protein synthesized within 60 min is 0.15 nmol L^{-1}. However, unit testing of the internal resource pool engagement showed that the protein yield reaches 0.30 nmol L^{-1}. Analyzing the model for RNA polymerase (RNAP) affinity showed that the batch can theoretically give a protein yield of 60 nmol L^{-1}. The model developed in this research can be used as a scaffold to formulate more complex models with constrained and nuanced biochemical parameters appropriate for industrial-scale pharmaceutics.

Code availability: The R codes used for this work are available at GitHub (https://github.com/zachariah-ibrahim/recombinant-DNA-expression).

Keywords: Recombinant DNA, mathematical modeling, gene expression

E-mail: suneth@sjp.ac.lk

623/E2

Use of concentrated solar radiation for the removal of Aflatoxin in coconut oil and assessment of compositional quality parameters after the treatment

M.P.G. Vanniarachchy* and B.V. Thimuthu Kasun

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Coconut oil is one of the most extensively used vegetable oils, but the susceptibility to carcinogenic mold contamination, Aflatoxin, poses a possible danger as a global health concern. Sri Lanka experienced a significant food outbreak in 2021 due to the discovery of aflatoxin contamination in coconut oils. Concentrated solar radiation was used in this study to investigate the ability of aflatoxin elimination. Quality assessment was done to address the miniscule number of research on quality evaluation following the application of solar radiation. Coconut oil samples were collected from the Colombo district, both branded and unbranded (n = 6). The initial aflatoxin content was analyzed by using high performance liquid chromatography (HPLC-FLD) system with AflaStar^{TM} FIT immunoaffinity column. Furthermore, initial iodine value (IV), saponification value (SAP) and free fatty acid (FFA) contents were determined, and the fatty acid profile was determined using the gas chromatography flame ionized detector (GC-FID). The oil samples were exposed to concentrated solar radiation for 10 minutes (T-1), 20 minutes (T-2) and solar radiation was recorded. Finally, the aflatoxin content (µg/kg or ppb) and IV, SAP, FFA were determined after each treatment. The total aflatoxin and aflatoxin B1 (AFB1) content of all coconut oil samples fell below the set European Union (EU) limits after each treatment (maximum permitted total aflatoxin content and AFB1 content according to EU standards, are 4 µg/kg and 2 µg/kg) with mean total reduction percentages of 94.00±6.48 and 98.67±2.80, for T-1 and T-2, respectively. Iodine values were found to be 9.085±0.842, 9.097±0.87, 9.133±0.876 (SLS requirement (R) lies from 7 to 11), SAP values were 255.52±2.91, 256.67±2.08, 256.23±2.69 (R is from 248 to 265) and FFA contents were 0.456±0.199, 0.501±0.207, 0.525±0.214 (max allowed is 0.8% of initial mass). T-1 and T-2 samples were within the permitted limits of SLS 32: 2017 edible coconut oil specifications. The fatty acid profile was also remained within the permissible range without any significant difference. According to the obtained results, to remove total and AFB1 aflatoxin tainted in coconut oil, treatment of 10 or 20 minutes at mean concentrated solar radiation of 971±29 w/m^2 or 945±65.4 w/m^2, respectively can be used.

Keywords: Aflatoxin, coconut oil, iodine value, oil quality, fatty acid profile

E-mail: mihiripg@gmail.com

624/E2

FTIR-based detection of dicyandiamide in dairy products

B.S.W Karunarathna[1]*, M.A.B Prashantha[2], N.G.D.D Nanayakkara[2], and
D.C.K.K Dissanayake[3]

[1] *Department of Chemistry, Faculty of Science, Eastern University Sri Lanka*
[2] *Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[3] *Life Sciences Division, Sri Lanka Atomic Energy Board, Wellampitiya, Sri Lanka*

One of the major issues in dairy industry is milk adulteration and the presence of chemical contaminants for financial benefit. One such contaminant is dicyandiamide (DCD) and an internationally accepted "safe limit" for DCD up to this date has not been reported. However, it is crucial to ensure milk products are free from DCD contamination. Using Fourier-transform infrared spectroscopy (FTIR), this study sought to provide a low-cost method for screening milk products for DCD. In this study, two potential peaks were identified at 2200 and 2160 cm^{-1} for milk solutions prepared by adding quantitative amounts of DCD. These two peaks showed a strong linear fit in the concentration range of 1-10 mg/ml (R^2 value of 0.92 for 2160 cm^{-1} and 0.97 for 2200 cm^{-1}). FTIR spectra obtained from the computational study (B3LYP/6-31G(d)) show two different N-C-N stretching at 2200 cm^{-1} and 2160 cm^{-1} relevant to each tautomer. Therefore, a separate calibration plot was developed integrating area under 2200 and 2160 cm^{-1} peaks instead of using single peak intensity. Local raw milk, fresh milk products, and milk powder solutions adulterated with known concentrations of DCD were used to validate calibration plots. For each calibration plot, a strong linear fit with R^2 values closer to 1 was obtained (0.99 for 2200 cm^{-1}, 0.99 for 2160 cm^{-1}, and 0.99 for peak area). The validation of the calibration plots gave a recovery percentage of 106 ±13.13% for all the curves (2160 cm^{-1}, 2200 cm^{-1}, peak area) on average and without any sample pretreatment. A minimum detection limit (LOD) of 0.49 mg/ml and a minimum quantification limit (LOQ) of 1.48 mg/ml was obtained for the calibration plot of 2160 cm^{-1} peak intensity. The findings of this study will be beneficial for the food and dairy industry.

Keywords: Dicyandiamide, FTIR spectroscopy, adulteration, milk, calibration curve

E-mail: baggya.karunarathna@gmail.com

625/E2

Synthesis and characterization of ethylenediamine sulfonamide derivatized zinc and platinum complexes towards fluorescence imaging applications

D.H.S. Witharana and N.T. Perera*

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

In the continuous search of metal-based anticancer drugs as alternatives for platinum compounds, zinc is a top candidate, being the second most abundant trace element in the body that is involved in many physiological functions. This is a comparative study where the chemistry of platinum and zinc complexes of novel N-sulfonamido ligands is explored. The ligand system is amphipathic with ethylenediamine (en) as the carrier ligand, which incorporates hydrophilicity and facilitates binding with the target site. On the other hand, the bulky aromatic fragment of the sulfonamide moiety provides lipophilicity and fluorescent properties. Two novel ligands (L1= N(SO$_2$quinoline)en), (L2 = N(SO$_2$iodobenzene)en), and their platinum complexes (C1 = [PtCl(DMSO)(N(SO$_2$quinoline)en)]), (C2 = [PtCl(DMSO)(N(SO$_2$iodobenzene)en)]) and the zinc complexes (C3 = [ZnCl(MeOH)(N(SO$_2$iodobenzene)en)]), (C4 = [ZnCl(MeOH)(N(SO$_2$azobenzene)en)]) were synthesized in this study. Characterization of the synthesized ligands and complexes were done using TLC analysis, UV-visible, FTIR and ^{1}H NMR spectroscopy in addition to fluorometric studies. The product formation, reaction completion and the purity were confirmed using TLC analysis. UV-visible spectra of the novel complexes showed shifts in peak positions compared to that of the starting materials due to metal to ligand charge transfer transitions and FTIR analysis confirmed the formation of new ligands by the presence of a vibrational S-N band at 820-840 cm^{-1}. ^{1}H NMR spectra show the aromatic protons in the range 7–10 ppm and the methylene protons between 2–3.2 ppm. The peaks related to NH protons were not observed in the ^{1}H NMR spectra of the ligands due to free rotation. The fluorescence of the complexes has either enhanced or quenched based on the ligand system as a result of rigidification upon binding to the metal or direct coordination of the fluorophore, respectively. The higher degree of enhancement in fluorescence intensity when the sulfonamide ligand is coordinated to zinc in comparison to platinum can be attributed to the heavy atom effect of platinum. Presence of fluorescent properties in these ligands and complexes can be utilized in potential diagnostic and theranostic applications.
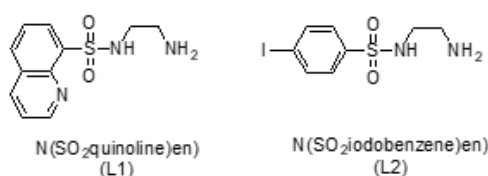
Fig 1 The structures of N-sulfonamido ligands

Keywords: Anticancer, ethylenediamine sulfonamide, zinc, platinum, fluorescence

E-mail: theshi@sjp.ac.lk

626/E2

Synthesis and characterization of novel copper dipicolylamine sulfonamide complexes toward possible biological applications

B D T Hansini and N T Perera*

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

The 2,2'-dipicolylamine (dpa) motif has been employed as a tridentate or bidentate coordinating donor ligand in synthetic inorganic chemistry. Since copper is a bio-essential element in all living organisms and is less hazardous than some non-essential metals like platinum, the synthesis and exploration of copper-containing metal complexes have attracted much attention. Copper compounds have demonstrated intriguing anticancer and antimicrobial effects in recent studies. Furthermore, due to the low cost, minimal toxicity, and excellent efficacy against bacterial infections, N-substituted sulfonamides continue to be among the most often used antibacterial medicines in the world. In this study, $N(SO_2)(1\text{-}nap)dpa$ (L1), $N(SO_2)(2\text{-}nap)dpa$ (L2), and $N(SO_2)(bip)dpa$ (L3) have been used as ligands to explore the complexation towards the Cu(II) metal center. The first ever reported Cu-dpa-sulfonamide complexes, $[Cu\{N(SO_2)(1\text{-}nap)dpa\}Cl_2]$ (C1), $[Cu\{N(SO_2)(2\text{-}nap)dpa\}Cl_2]$ (C2), $[Cu\{N(SO_2)(bip)dpa\}Cl_2]$ (C3), and $[Cu\{N(SO_2)(bip)dpa\}_2](PF_6)_2$ (C4) were synthesized and characterized using UV-vis spectroscopy, fluorescence spectroscopy and FTIR spectroscopy. Synthesis of each metal complex, completion of the reaction, and the purity of each product were monitored using TLC analysis. The absorption peaks at 200-250 nm in UV-visible spectra indicate the presence of intra-ligand $\pi\rightarrow\pi^*$ and $n\rightarrow\pi^*$ transitions. In addition, a Bathochromic shift for complexes (C1), (C2), (C3), and (C4) have been identified in UV-visible spectra. As per FTIR spectroscopic data, the C=C and C=N stretching frequencies of the complexes have shifted to lower frequencies than those of their ligands, suggesting the formation of a new link between Cu and N that weakens the C=C and C=N bonds. Moreover, the coordination of the pyridine nitrogen to the copper(II) ion was indicated by the bands at 610 cm^{-1} and 690 cm^{-1}. In contrast to the mono-substituted $[Cu\{N(SO_2)(bip)dpa\}Cl_2]$ (C3), bis-substituted $[Cu\{N(SO_2)(bip)dpa\}_2](PF_6)_2$ (C4) has shown a hyperchromic effect with a shift to the longer wavelength region due to the extended conjugation of the C4 metal complex. Complexes C2, C3, and C4 are fluorescent, although they exhibit lower fluorescence than the corresponding ligand, indicating that fluorescence was quenched upon coordination with Cu. The novel copper complexes are to be further investigated for their coordination between the ligands and the metal center and also for their importance in biological applications.

Keywords: Dipicolylamine sulfonamide, copper, fluorescence, quenching

E-mail: theshi@sjp.ac.lk

627/E2

Microwave-assisted synthesis of silica-supported indole-derived fluorometric chemosensor for the detection of Fe^{3+} ions

A.U.T. De Silva and K.G.U.R. Kumarasinghe*

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

Recently, organic-inorganic hybrid material-based fluorescent chemosensors have gained considerable attention for the detection of metal ions. The significance of fluorescent chemosensors has been expanded to various fields due to their selectivity, sensitivity, and non-destructive nature. In this study, a silica-supported indole-derived fluorometric chemosensor under microwave irradiation was developed as an efficient chemosensor for the detection of Fe^{3+} ions. Nanosilica obtained from rice husk *via* sol-gel process was functionalized by 3-(aminopropyl)triethoxysilane (APTES) followed by covalent grafting of para-aminobenzoic acid, benzaldehyde, and indole organic moieties to synthesize the novel organic-inorganic hybrid nanomaterial. The main advantages of this work include simple operation, easy work-up procedure, low-cost, improved efficiency, and mild reaction conditions. Characterization of the chemosensor material was performed by Fourier transform infrared (FTIR) spectroscopy, fluorescence spectroscopy, and thermogravimetric analysis (TGA). The weight loss analysis of TGA confirmed the successful grafting of organic moieties into the silica matrix. Furthermore, the results obtained from scanning electron microscopy (SEM) suggested that the particle size of nanosilica and APTES@nanosilica was approximately in the range of 65-75 nm in agglomeration form with a roughly spherical shape. In comparison to certain metal ions such as Co^{2+}, Zn^{2+}, Cd^{2+}, Mn^{2+}, and Cu^{2+}, observable variations in fluorescence intensity were noted with Fe^{3+} ions. Thus, it was revealed that the silica-supported indole derivative could precisely bind with Fe^{3+} and acts as an indole-derived fluorometric chemosensor for Fe^{3+}. Furthermore, the synthesized ligand exhibits extremely effective fluorescence-enhanced, "Turn-ON" chemosensor activity towards Fe^{3+} at the excitation wavelength of 355 nm. Additionally, the limit of detection and limit of quantification were evaluated. Further characterization will be performed by elemental analysis to examine the elemental composition of the silica-supported indole derivative. The findings of this study suggest that silica-supported indole derivative can be utilized as a selective and sensitive, Turn-ON fluorometric chemosensor for the detection of Fe^{3+} ions.

Keywords: Indole, chemosensor, Fe^{3+}, Turn-ON

E-mail: upulk@sjp.ac.lk

628/E2

Amine functionalized mesoporous silica nanoparticles incorporated electrospun cellulose acetate nanofibers for effective removal of CaCO₃ in drinking water

S.H. Kumarage and I. Munaweera*

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

The world is steadily edging closer to a future where there won't be enough clean water for consumption due to the growing urbanization and global population. Even today, many people lack access to clean and safe water. Water hardness, which is one of the most important factors affecting water quality, needs to be alleviated by water softening. A simple and affordable method of water softening has been developed by incorporating amine-functionalized mesoporous silica nanoparticles (AMS) into cellulose acetate (CA) electrospun fiber membranes. AMS was synthesized by microwave-assisted sol-gel method. The efficient synthesis of AMS was verified using images from scanning electron microscopy (SEM), dynamic light scattering (DLS), and Fourier transform infrared spectroscopy (FTIR). The noticeable peak at 1053 cm^{-1} denotes the Si-O-Si bond, while peaks at 3373 cm^{-1} and 1636 cm^{-1}, which correspond to N-H stretching and bending, respectively, verified the successful synthesis of silica and amine functionalization. The nano-sized (100-350 nm) AMS particles synthesis was well proven by the SEM and DLS results. The AMS nanoparticles were properly integrated into the nanofiber membranes, as evidenced by SEM pictures, FTIR analysis, and X-ray photoelectron spectroscopy (XPS) data. The XPS peaks at 100.4 eV (Si_{2p}) and 398.81 eV (N_{1s}) confirmed the integration of AMS onto the nanofiber membranes. Calcium ion removal of the samples were analysed using atomic absorption spectroscopy (AAS). A 65% calcium ion removal was shown by 50 wt% AMS/CA membrane from a solution with 200 ppm initial concentration at a pH of 7.3 under dynamic settings with a 5 mg/mL of the membrane dosage. Contrarily, only 19% of the calcium ions were removed from the pure CA membrane, showing that the majority of calcium ion removal in the AMS/CA nanocomposite membrane occurs by chelation *via* the -NH groups of AMS. The study of pH effect on calcium ion removal showed that the removal increased with the increase of pH from 3 to 7 and then decreased when the solution became basic until pH11. Thus, the affordable biodegradable AMS/CA nanocomposite membranes offer great potential in water softening.

Keywords*:* Amine modified silica, cellulose acetate, electrospinning, water hardness, water softening

E-mail*:* imalka@sjp.ac.lk

629/E2

Synthesis, characterization and release kinetics of antibiotic-loaded mesoporous silica nanoparticles

V.V.R.P. Subasingha [1], L. Wijenayaka [2], M.D.J. Wijayabandara [1] and R.K. Dissanayake[1] *

[1] Department of Pharmacy and Pharmaceutical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2] Department of Chemistry, Faculty of Natural Sciences, The Open University Sri Lanka

Emerging microbial resistance to the currently available antibiotics is a global concern. Antibiotic-loaded nanoparticles play a vital role to combat antimicrobial resistance in different ways. Targeted delivery, sustained release and synergetic actions are some of them. Mesoporous silica nanoparticles (MSNs) are porous structures with a large number of pores that are capable of adsorbing relatively large amounts of molecules. Therefore, MSN has been investigated as a nano-carrier for effective intracellular delivery of antibiotics. MSNs can be synthesized using different methods by various types of precursors. Here, MSNs were synthesized using two precursors: (1) rice husk (RH) and (2) Tetraethylorthosilicate (TEOS) *via* a sol-gel pathway by using cetyltrimethylammonium bromide (CTAB) as structure directing agent. Synthesized nanoparticles were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Fourier transform infrared (FTIR) spectroscopy with the size of nanoparticles ranging between 100–120 nm. Evidence confirmed that MSNs were successfully synthesized from both precursors (RH and TEOS) with homogeneous morphology and apparent porosity. Then the MSNs were successfully loaded with chloramphenicol and erythromycin using vacuum evacuation process. Eventually, their antimicrobial assays were performed using Gram-positive and Gram-negative bacterial species (*Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Escherichia coli*) and release studies were evaluated. According to the loading studies, MSN-TEOS-Erythromycin showed the highest loading capacity. The release studies indicated that both MSNs consist of a sustained release profile of antibiotics. Compared to the MSN-RH, MSN-TEOS showed a good, sustained release profile. Both antibiotic-loaded MSNs showed promising antimicrobial activity against tested Gram-positive and negative bacterial strains. Erythromycin-loaded MSN-RH showed the highest inhibition while erythromycin-loaded MSN-TEOS showed the lowest inhibition activity. Antibiotic-loaded MSNs showed high loading capacity and a sustained release profile with promising antimicrobial activity. Hence, antibiotic-loaded MSN is a good alternative to achieve a sustained release profile and mitigate antimicrobial resistance.

Keywords*:* Antibiotic, drug delivery, mesoporous silica nanoparticle

E-mail*:* rangad@sjp.ac.lk

630/E2

Bioactivity directed isolation of a rare phytosterol, stigmast-5-en-3*β*,7*α*,22*α*-triol from *Leea indica*. (Burm.f.) Merr. with wound healing potential

W.M.P. Samarasinghe[1], C. Ranasinghe[1], K.H. Jayawardana[2], S. Somaratne[3], and
G.M. K. B. Gunaherath[1]*

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

Leea indica (Burm. f.) Merr. has been used in Ayurveda for the treatments of wounds, in particular for burns. Wound healing is a natural process in which cell proliferation and migration are key events. The present study aimed to investigate the compounds present in *Leea indica* having potentially wound healing activity. Hexanes, dichloromethane, ethyl acetate, and methanol extracts of bark of *L. indica* were obtained by sequential extraction of the dried plant material with respective solvents at 30±2 ⁰C for 24 h. Each extract was subjected to scratch wound assay (SWA), which is used as the guiding bioassay to study horizontal or one-dimensional cell migration, at a concentration of 20 mg/L on Madin-Darby canine kidney (MDCK) cells. Since MDCK cells are epithelial cells, which grow as a monolayer of cells, the scratch made in monolayer of MDCK cells in this *in-vitro* assay mimic normal wounded tissue. The assays were carried out in triplicate along with the negative control (1% dimethyl sulfoxide in 20% Dulbecco's Modified Eagles Medium) and the positive control (asiaticoside) at a concentration of 25 *μ*M. The cell migration ability was expressed as the mean percent wound closure at 24 h. Of these four extracts, the highest mean percent wound closure (74.0%) was shown by the dichloromethane extract. Bioactivity-guided fractionation of the dichloromethane extract of bark of *L. indica* led to the isolation and identification of a rare phytosterol, stigmast-5-en-3*β*,7*α*,22*α*-triol (**1**) as the potential wound healing active compound. Cell migration ability of **1** at 24 h was determined at a concentration of 12.5 *μ*M

(**1**)
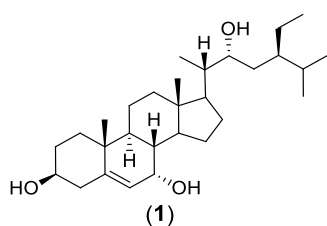
and its mean percent wound closure was found to be 86.4%. The identity of stigmast-5-en-3*β*,7*α*,22*α*-triol (**1**) was established by the analysis of NMR spectroscopic data and confirmed by the comparison of ¹H-NMR and ¹³C-NMR data with those reported. This constitutes the first report of the presence of the stigmast-5-en-3*β*,7α,22α-triol from *L. indica*, which is a rare phytosterol previously reported only from *Verbena littoralis* and *Corylus avellena*.

Keywords: Phytosterol, wound healing, *Leea indica*, extracts

E-mail: kbgun@ou.ac.lk

631/E2

Isolation and structure characterization of a hypoglycemically active flavone glycoside from Sri Lankan green leafy vegetable *Olax zeylanica* (Malla)

M.G.A.N. Perera[1,*], N.G.D. Anuradha[1], S.M.D.S. Gayathri[1], A.W.P. Rasangani[1], P.G.I. Dias[1], R. Sabaragamuwa[1], T.C. Kananke[1], R.M.K.T. Rathnayaka[1], M.N. Wickramaratne[2] and R.M.U.S.K. Rathnayake[1]

[1]Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka
[2]Faculty of Medicine, Sabaragamuwa University of Sri Lanka

The tender leaves of *Olax zeylanica* (Family Olacea) have been extensively used as a green vegetable by rural population of Sri Lanka and known to have good hypoglycaemic properties. In the present study, hypoglycemic activity of methanol extracts of *Olax zeylanica* leaves was investigated. The methanolic extract of dried leaves gave a brown coloured precipitate upon concentration followed by addition of 98% ethanol. This brown precipitate was further fractionated with an open column filled with C-18 stationary phase (100 x10 mm) using methanol and 1% acetic acid in water as the mobile phase. The fraction eluted with 50-80 % methanol (in 1% acetic acid) was dried under vacuum followed by lyophilization gave an off white amorphous solid. LC-MS profile showed the presence of two molecular ions (M+H) at 579 and 697. Further separation using a second C-18 column yielded a substantially pure compound, which formed a yellow-coloured complex with 10 % $AlCl_3$. Further, UV and FTIR spectra clearly indicated the presence of a flavonoid structure in the isolated compound. Proton and ^{13}C NMR spectral studies indicated the presence of an unidentified Flavone 7-O-glycoside ($C_{27}O_{14}H_{30}$, calculated relative molecular mass 578). NMR studies further indicated that the sugar moiety was composed of two monosaccharide residues, α-glucopyranose (anomeric signals at 5.56 ppm, 99 ppm) and α-rhamnopyranose (anomeric signals at 5.30 ppm, 102 ppm) probably forming a neohesperidosyl unit. The isolated compound inhibited α-glucosidase with IC_{50} of 2.43±0.07 ppm and lipid peroxidation in egg yolk with IC_{50} of 95 ppm. Further structural characterization is required for the complete understanding of the chemistry and biological importance of the compound.

Keywords: *Olax zeylanica,* hypoglycemic activity, lipid peroxidation, Flavone 7-O-glycoside

E-mail: namalperera@appsc.sab.ac.lk

632/E2

Study on the variation of volatile flavor compounds of black tea during the fermentation process

S.T.N. Yasaswin[1], K.G.N. Piyasena[2], L.S.K. Hettiarachchi[2], D.D.C. de S. Wanniarachchi[3]*

[1]Instrument Center, Faculty of Applied Science, University of Sri Jayewardenepura, Sri Lanka
[2]Tea Research Institute of Sri Lanka, Thalawakele
[3]Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka

The processing conditions strongly influence the taste, aroma, and liquor color of black tea. The fermentation/oxidation/aeration is the key stage where such quality-related compounds are developed. When tea particles ("Dhool") are exposed to air, the oxidation of biochemical compounds leads to the development of a unique aroma varying from "grassy" to "sweet" scent during the fermentation stage. As monitoring of the variation of aroma compounds during fermentation for Sri Lankan tea is important, this research focused on studying the variation of the composition of volatile compounds in black tea aroma during the fermentation. Samples were collected from St. Coombs Tea Factory. The first "dhool" tea samples were collected every 15 minutes during the fermentation and immediately oven-dried at 120 °C for 20 minutes. The biochemical compounds were identified by solid-phase micro-extraction (SPME) followed by gas chromatography-mass spectrometry (GC-MS) analysis. Seventy-two tea volatile compounds were identified and classified into chemical groups of aldehydes, ketones, esters, alcohols, and hydrocarbons while quantity of each compound was calculated as a percentage (%) using their total peak area of GC chromatograms. Variation of content of those groups during fermentation was determined. Results exhibited that the composition of hydrocarbons was progressively reduced from $29.02 \pm 0.18\%$ to $22.89 \pm 0.16\%$, while the content of alcohols and esters fluctuated around 26% and 4%, respectively. Content of aldehydes increased (from $5.25 \pm 0.05\%$ to $8.88 \pm 0.12\%$) while content of ketones decreased (from $3.01 \pm 0.03\%$ to $1.80 \pm 0.02\%$) with the fermentation time. *E*-2-hexanal and *cis*-3-hexenol are classified as volatile flavour compounds (VFC) Group I that produce a grassy odor, and linalool, linalool oxides, methyl salicylate, phenyl acetaldehyde, geraniol, benzyl alcohol, 2-phenylethanol, and ionone as VFC Group II, that generate a sweet flowery aroma. These two groups were used to calculate the flavour index and it demonstrated an increasing trend with the fermentation time reaching the value of 5.23 at the end of the fermentation process, which was initially 2.94. These findings are extended in research to develop an instrument to determine the optimum fermentation time for black tea.

Keywords*:* Black tea, fermentation process, volatile compounds, flavor index

E-mail*:* dakshikacw@kln.ac.lk

633/E2

Assessment of formaldehyde contents of selected fish species harvested by multi-day boats in Mirissa, Kudawella and Tangalle fishery harbors in Sri Lanka

S.M.M.R. Bandara[1], G.S.A. Senanayake[1*], K.W.S. Ariyawansa[2], M.G.C.R. Wijesinghe[2] and M.M. Subasinghe[2]

[1]*Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Analytical Chemistry Laboratory, National Aquatic Resources Research & Development Agency (NARA), Colombo 15, Sri Lanka*

Seafood is a nutrient-dense commodity that is widely consumed around the world. The illegal addition of formalin (37% formaldehyde) to seafood for the purpose of extending shelf life has a negative impact on consumer health because it has been identified as a potential carcinogen by the International Agency for Research on Cancer (IARC). The current study was carried out to conduct a quantitative analysis of formaldehyde contents in selected fish species by a UV spectrophotometer based on absorbance (measured at 412 nm) using Nash reagent in conjugation with trichloroacetic acid (TCA) extraction. Skipjack tuna (*Katsuwonus pelamis*) and Indian scad (*Decapterus russelli*) were chosen as experimental units for this study. Fish samples were collected from Mirissa, Tangalle, and Kudawella fishery harbors from multiday boats as well as single day boats for control samples and all were evaluated for formaldehyde concentration. Multi-day boats typically fish for 60 days at a time with the first 20 days catching C-grade fish, the next 20 days catching B-grade fish, and the final 20 days catching A-grade fish in terms of quality. The mean formaldehyde concentration in fish collected from fishing harbors ranged from 0.024 to 0.163 mg/kg. The values were higher in Kudawella Skipjack tuna and Indian scad fish where the average values were 0.154 and 0.158 mg/kg, respectively. There was no correlation between fish grade and the deviation in formaldehyde content. However, the mean formaldehyde contents were higher in all the samples than the control samples for skipjack tuna (0.035 mg/kg) and Indian scad (0.046 mg/kg) fish. This study concluded that fish from Kudawella harbor contained more formaldehyde than fish from the other two harbors, and Skipjack tuna and Indian scad fish from the three harbors, Mirissa, Kudawella, and Tangalle, are safe for human consumption as formaldehyde levels were below the restricted level of formaldehyde in fish (5 mg/kg).

Keywords*:* Formaldehyde, fishery harbours, UV spectrophotometer

E-mail: surajisena@gmail.com

634/E2

Occurrence of *trans*-fatty acid positional isomers in commercially available plant oils and oil-based products in Sri Lanka

W.I.M. De Silva and H.P.S. Senarath*

Department of Food Science & Technology, Faculty of Livestock, Fisheries, & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka

Plant lipids are a good source of unsaturated fatty acids, such as linoleic and linolenic acids. In some of the manufacturing steps of plant oil/oil-based products, *i.e.*, deodorizing, refining, and partial hydrogenation, fatty acids can convert their naturally occurring *cis*-form into *trans*-form and positional isomers. These *trans*-fatty acids (TFA) positional isomers can be adversely and differentially affected on human health by causing cardiovascular disease, diabetes, *etc.* In Sri Lanka, no studies were reported on the content of TFA positional isomers in plant oil-based products. Thus, this study was carried out to investigate the occurrence and distribution of common TFA positional isomers in commercially available plant oils in Sri Lanka and to compare the content with recommended levels for TFA. By conducting a consumer survey and a market survey, commonly consumed plant oil types were selected. According to the survey results, 10 samples including 7 refined oils and 3 partially hydrogenated vegetable oils (PHVO)/ margarine were selected for the study. Lipids were extracted from PHVO by using modified Bligh and Dyer method, followed by the Boron trifluoride (BF_3) transmethylation of oil samples to formulate the fatty acid methyl esters. Ag^+ solid phase extraction was carried out to separate *cis/trans* isomers in the samples. Gas chromatography (GC) fitted with flame ionization detector and GC–mass spectrometry were used to analyze the total fatty acid composition and the *cis/trans* positional fatty acid isomers of samples (n = 3), respectively. In analyzed samples, *cis*-fatty acids were always more prominent than the *trans*-fatty acids with traces of TFA. C18:1 *trans*-fatty acids were prominent (>75%) in all analyzed samples except sunflower oil and corn oil. C18:1 *t*9 was the major *trans* positional isomer found in coconut oil (>84%), sesame oil (80%), olive oil (>94%), palm oil (>96%) and a margarine sample (>32%). C18:2TT was the most prominent (>80%) TFA in sunflower oil and corn oil. In conclusion, although the relative daily intake value of TFA was 0%, most of the people ingest TFA beyond that recommendation due to the occurrence of TFA in edible processed plant oils and oil-based products.

Keywords: Plant oil, *cis/trans*-fatty acids, TFA, positional isomers

E-mail*: s.senarath@wyb.ac.lk

635/E2

Quantitative analysis of microplastics content in Sri Lankan Sea salts

A.P.W Sulochana[1], C.W Subasinghe[2] and K.M.T.D Gunasekera[3]*

[1]College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya, Sri Lanka
[2]Department of Biochemistry and Clinical Chemistry, University of Kelaniya, Sri Lanka
[3]Department of Polymer Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Sri Lanka (SL) has been listed as the fifth marine plastic polluter in the world in 2017 with plastic waste generation about 1.59 MMT/year, and larger fraction ending up in the oceans. Plastic waste degrades into small fragments with time. When size of these fragments is less than 5 mm, they are classified as microplastics (MPs). Since traditional salt manufacturing process involves solar evaporation of sea water, MPs can be easily trapped in salt and enter human body. There is a considerable amount of literature available globally about MPs in edible salt and their downstream health effects, but unfortunately very limited research has been conducted in SL. This study quantitatively analyzed five commercial salt brands in SL and salt produced during three weather seasons (first-inter monsoon, south-west, and north-east monsoon) at Hambantota saltern for MPs. Microplastic extraction was done by filtering through a mesh system (5.00 & 0.25 mm) followed by wet peroxide oxidation with $FeSO_4.7H_2O$ and 30% hydrogen peroxide. Microplastics identification and enumeration were done using a dissecting microscope and hot needle test was conducted to confirm plastics. In order to statistically analyse the obtained microscopic results, one-way single factor ANOVA test was conducted while comparison between samples were done by comparing variance. The statistical tests were performed using SPSS (Statistical Package for the Social Sciences) software. Results indicated presence of MPs in all samples ranging from (10±5 to 108±53) MP/kg. Microplastics in commercial salts vary from (10±5 to 46±3) MP/kg whereas salts from Hambantota saltern reported relatively high MPs content varying from (26±6 to 108±53) MP/kg. Most abundant MP type was fragments (46%) followed by fibres (32%), nurdles (13%), and microfilms (9%). According to results, there was no variation of MPs between commercial salt brands. There was a seasonal variation of MPs between first-inter monsoon season and south-west and north-east monsoon season samples. Salt produced during south-west monsoon season reported the highest MPs content (108±53 MP/kg). Results are alarming as MPs accumulated in human body can impart many health risks including but not limited to endocrine, respiratory and cancers.

Keywords: Microplastics, sea salt, Sri Lanka, quantitative analysis

E-mail: thilinidg@sjp.ac.lk

702/E3

Fake news identification approaches in Social Media Networks

H.G.H.S. Hathnapitiya* and S. Ahangama

Department of Information Technology, University of Moratuwa, Katubedda, Sri Lanka

News is the communication mechanism that retains people informed about the incidents that are happening in the world. Communicating media is required to spread the news among people. Because of their low cost, speed, and usability, the internet, and social media platforms have made it easier to access news from anywhere in the world. False news articles that contain fake information to mislead society have taken over social media and become ingrained in many people's lives. Even though it is a challenging task, early detection of fake news is more important to mitigate the severe negative impact that it can have on society. The aim of this paper is to determine and study the methodologies followed in available studies to detect fake news on social media networks. A search phrase is used to retrieve relevant research articles from the selected digital libraries. Many researchers researched to identify fake news published in English. Previous scholars have used several methods using various attributes related to the early identification of fake news. Approaches to detecting fake news can be divided based on the features used to implement the algorithm. Content-based methods use content-related elements such as titles, body text, and images. Social features such as profile information, comments, retweets, and diffusion networks are used in social context-based methods. Some authors combined content and social features to develop a hybrid system for improving prediction capability. It is paramount to apply text preprocessing, embedding, and feature extraction steps that can satisfy available Natural Language Processing (NLP) techniques. Researchers have used machine learning and deep learning techniques like Support Vector Machine, Decision Tree, Convolution Neural Network, and Recurrent Neural Network for fake news identification. Validation results of existing studies proved that content features contribute more than profile information in fake news identification. Despite detecting English fake news, only a few attempts in Sinhala are available. There is a gap in the early detection of social media fake news with low-resourced languages like Sinhala. The introduction of a novel approach for early detection of Sinhala fake news can fill a research gap.

Keywords: Fake news, social media, natural language processing

E-mail: sandunikahathnapitiya@gmail.com

703/E3

Predicting optimal life insurance policy premium using Random Forest

K.K.L.Ranasinghe* and D.D.M. Ranasinghe

Department of Electrical and Computer Engineering, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

A life insurance policy is a contract between the insurer and the policy holder to mitigate the life risk factors of the policy holder for a specific time period by paying the maturity in lieu of the premium paid. Sustaining a life insurance policy throughout the policy term is a challenge and many policies are abandoned abruptly due to the inability of paying the premium on a regular basis. Usually, the premium calculation is done by the insurance agent based on the customer data. These lapsed life insurance policies significantly impact the life insurer as well as the Life Insurance Company in a negative manner because neither party gets any benefit or revenue. Though there are few existing systems that predict the optimal premium, these systems cannot be adapted to the local scenario mainly due to disparities in customer data. Hence this research focuses on developing a model for predicting age category wise premium. The data set was collected from a real insurance company and comprise nine (09) input parameters with 5312 data points. An ensemble approach was adapted to develop the model and the highest accuracy of 80.09% was obtained from the random forest machine learning algorithm. Parameter tuning of the random forest model was carried out using GridSearchCV method in sklearn and the final model was saved with a web interface. User testing of the system was done by a set of experienced insurance agents and concluded that the system can be used as a useful guide for Insurance Agents despite of minor differences in the predicted premium vs the calculated premium. The web interface facilitates any customer to calculate the predicted premium for a given set of input values, thus educating the customer before signing the insurance contract.

Keywords: Premium, machine learning algorithm, random forest

E-mail: kushanou@gmail.com

801/F

The social cost of plastic pollution: are we willing to pay more for a cleaner coastline?

S.M.S.N. Senanayake, J.M.M. Udugama and G.A.N.D. Ganepola

Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka

Plastic contamination of coastlines and oceans is widely acknowledged as one of the leading and critical marine environmental pollutions in the world. Consequently, Sri Lanka's economically valuable coasts have also become more contaminated by microplastic and plastic trash. In contrast, plastic pollution in the marine environment is a serious concern in Sri Lanka due to inadequate waste management, consumer patterns, and dumping. Therefore, the specific objectives of this research were to determine the public preference to reduce marine plastic litter, to determine the public's WTP for a beach cleanup program, and to estimate the social cost of plastic pollution. Accordingly, the present study employs the Contingent Valuation Method (CVM) using a Probit regression which was performed to elicit the willingness to pay (WTP) from local and foreign visitors focusing on 14 beaches in the Western and Southern Provinces. Data were collected through face-to-face interviews employing a semi-structured questionnaire, beginning from November 2021 to February 2022. SPSS 28.0 software was utilized to analyze 227 (54%) locals and 193 (46%) international tourists. Additionally, using Likert scale statements, visitors' perception was performed as a Confirmatory Factor Analysis (CFA). An index was performed to measure the factors like awareness, environmental knowledge, and environmental concern. According to the findings, 82% of local and 77% of foreign individuals stated their WTP for the beach cleanups. Moreover, occupation and gender variables had a positive impact on WTP for a beach cleanup. Therefore, the Probit model revealed that local female government employees stated a higher WTP for sustainable beach cleanliness compared to their men's counterparts. It seemed that social and environmental knowledge significantly affected their decision to spend an average of 3.4 hours per day cleaning the beach. The social cost of plastic pollution for beach users including fishermen was LKR 59 422.36 while the average monthly WTP was LKR 2 819 per user. The results emphasized the significance of researching user preferences and economic valuation techniques to implement sustainable development and planning measures, such as charging an entrance fee to protect coastal habitats and marine resources.

Keywords: Plastic pollution, willingness to pay, social cost of pollution, coastal habitats

E-mail: menukaudugama@gmail.com

802/F

Identification of the determinants of adults' food purchasing habits and diet quality

M.A.B.G Dharmadasa and A.M.N.T Adikari*

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

People are more concerned about their diets because poor diet quality is directly linked to the occurrence of diet-related diseases. Although food purchasing habits are a crucial factor in determining the quality of diet, limited research has been carried out to determine the food purchasing habits of adults that influence diet quality. The aim of this study was to fill this research gap by identifying the determinants of food purchasing habits and their association with the diet quality of adults. Adults who purchase food for households (HHS) in Kurunegala District were conveniently selected. Information on socio-demographic characteristics and the determinants of food purchasing habits of adults were gathered using an interviewer-administered lifestyle questionnaire. A 3-day diet diary was used to collect dietary data. Diet Quality Index-International (DQI-I), which is a measure of the quality of the diet was used to evaluate the quality of the diet. The DQI-I measures dietary diversity, adequacy, moderation, and overall balance of a diet. Food-Base 2000 software was used to assess dietary data. Simple descriptive statistics were performed to analyze socio-demographic characteristics and determinants of food purchasing patterns. DQI-I scores that are close to 100 are regarded as indicators of good quality diets. SPSS software was used to analyze statistical analysis. A study sample consisted of 113 adults and their ages ranged from 18 to 65 with a mean age of 50.3±8.9 years. Results showed that nutrition information, taste, price, expiry date, the ingredient list of the food, easiness of food preparation, and location of food outlets were the determinants of purchasing habits of the sample. The mean DQI-I value of the sample was 63.27±10.03 and 88% of the adults had DQI-I values ≥50 which indicate that the majority had quality diets. The findings showed an association between socio-demographic parameters of ethnicity, occupation, level of education, and HH's monthly income and diet quality (p<0.05). Moreover, factors that influence food purchasing habits, such as price, the brand name, nutrition information of the food, overall quality of food in terms of freshness and storing as well as keeping conditions, easiness of food preparation, and location of the food outlets, were significantly (p<0.05) associated with the diet quality. Since the diet quality of the study sample had an association with their food purchasing habits awareness of having healthy diets by following good purchasing habits is important to prevent diet-related diseases.

Keywords: Determinants, diet quality, DQI-I, food purchasing habits, households

Email: namalithakshila@wyb.ac.lk

803/F

The impact of socio-economic factors and consumer behavior on household food waste generation in Alpitiya Grama Niladhari Division in Kegalle, Sri Lanka

A.S. Kulathunga, P.C. Wanniarachchi and P.D.A. Abeysundara*

Department of Food Science and Technology, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

The generation of household food waste is a serious socio-economic and environmental problem that requires special attention in achieving the goal of sustainable consumption. This study focused on evaluating the impact of socio-economic factors and consumer behavior on household food waste generation in the Alpitiya Grama Niladhari Division, Kegalle, Sri Lanka. Responses were gathered from individuals (n = 75; convenient sampling/population 221 households), who prepare/purchase food at the home level using a researcher-administered questionnaire. Each household was introduced to a specially designed waste collecting bin and the separated waste was measured by the research group daily, for three consecutive days. The median avoidable food waste and unavoidable food waste generated within one household per day were 222.7g and 349.7g respectively (total food wastage is 580.7g per household per day). Results of the Kruskal-Wallis test revealed that the total food wastage generated per household was significantly different according to the income level, the number of family members, the number of family members who are under 18 years, and the fruits and vegetable purchasing frequency of the households ($p < 0.05$) where households with high income, more family members or members under 18 years and high purchasing frequency appeared to produce more food waste than others. Furthermore, Wilcoxon rank-sum test indicated that the total food waste generated within one household was significantly different across two groups ($p < 0.05$) whether they prepare a shopping list or not ($p < 0.05$). Households that prepare shopping lists appeared to produce a lesser amount of food waste than households that do not prepare such lists. In conclusion, the total food waste produced within a household in Alpitiya Grama Niladhari Division per day is impacted by the income level of the family, the number of family members, the number of family members who are under 18 years, the fruits and vegetable purchasing frequency, and whether they prepare a shopping list.

Keywords: Food waste, sustainable consumption, consumer behaviour

E-mail: piumi@sci.sjp.ac.lk

804/F

Identifying the consumer's expectations and availability of nutrition information on menu items in food outlets

M. I. M. Munasingha and A.M.N.T Adikari*

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

Presently, people tend to consume more food outside of their homes because of busy work schedules. With knowledge about nutrition and health, consumers are concerned about healthy food. Limited studies have been conducted to determine consumers' expectations and the availability of nutrition information on menu items in food outlets in Sri Lanka. The objective of this study was to identify consumers' expectations of nutrition information and to determine the availability of nutrition information on menus in food outlets. A cross-sectional study was conducted with conveniently selected 203 consumers and 30 food outlets. A pre-tested self-administered online questionnaire was used to collect data from consumers, and an interviewer-administered questionnaire was used to gather information from food outlets as in-person interviews and telephone interviews. Out of 203 selected consumers, 58.6% preferred to have nutrition information on menus in food outlets, and of those, 75% liked to have nutrition information manually on menu descriptions rather than on website displays. The major pieces of information that consumers expected to know about their meals obtained from outlets were calorie, carbohydrate, fat, cholesterol, protein, and sugar content. Fifty percent of consumers agreed that if nutrition information is available on outlet menus, the frequency of consuming food from food outlets will be increased due to the selection of appropriate menus according to their health condition. Only 6.9% of consumers had seen nutrition information on menus. Out of a total of 30 food outlets, only 5 (16.67%) had displayed nutrition information on their menus, and they provided information about carbohydrates, protein, fat, and sugar. Results of the study revealed that there was limited availability of nutrition information on menu items in food outlets, while more than half of the consumers preferred to know about the nutrition information on menus.

Keywords: Consumer expectation, food outlets, menus, nutritional information

E-mail: namalithakshila@wyb.ac.lk

805/F

Impact of awareness and perceived social support on life satisfaction: undergraduates' perspective

S.S. Weligamage

Department of Finance, University of Kelaniya, Sri Lanka

Social support, self, and social awareness can be identified as the essential sources for life satisfaction. High perceived social support is related to better psychical and psychological health. The main purpose of this research study was to assess the impact of self-awareness, social awareness, perceived social support on academic life satisfaction in the context of undergraduates' perspectives. Perceived social support from family, friends, individually important person, self-awareness and social awareness dimensions were selected as independent variables and perceived academic life satisfaction was identified as the dependent variable. This is a quantitative, cross-sectional questionnaire survey study. Primary data were collected through a questionnaire using convenient sampling which has met the standards of reliability and validity. 118 final year undergraduates were included in the analysis. Five hypotheses were developed to test the model. Data analysis was done with the aid of statistical software, employing the techniques of descriptive statistics, correlation, regression, and factor analysis. Findings revealed that students' self-awareness (0.289), social awareness (0.380), social support from family (0.303) and social support from friends (0.339) have a significantly positive relationship with academic life satisfaction. Regression results show that 49.5% of total variation in academic life satisfaction is explained by all the independent variables included in this study and family support, friend support, and social awareness significantly impact life satisfaction and self- awareness and support from individually important person not significantly impact their academic life satisfaction. Findings also revealed that they do not think identifying their strengths/ weaknesses and working on those aspects impacts their academic life satisfaction. These findings indicated that though self-awareness and individually important person support are impacted highly for emotional events at once life, undergraduates' do not take those as an essential part in their life satisfaction. Hence, more education should provide them with understanding the important of self-awareness on their own personality development, keeping close relationship with a special person to share their joys and sorrows in order to enhance their life well-being.

Keywords: Social support, life satisfaction, self-awareness, social awareness

E-mail: susima@kln.ac.lk

806/F

Identifying the role of satisfaction between experience quality and revisit intention of international guests visiting five-star hotels of Sri Lanka

Nishadi Rajapakshe

Department of Economics, University of Colombo, Colombo, Sri Lanka

Customer satisfaction is important for the continued presence of businesses in this contemporary world and tourism industry is not an exception. A large number of studies have discovered that it costs about fivefold the amount of time, money, and assets to draw in another client as it does to hold onto a current client. Researchers state that travel destinations can likewise be seen as an item which can be revisited and prescribed to other potential travelers. The satisfaction that tourists experience in a particular destination is a determinant of the tourist's revisiting. Then, consumer satisfaction and positive behavioural intentions are basic achievement factors for hotels. A positive mind-set can only be achieved by making customers delighted with memorable experiences that have high perceived experience quality. Therefore, it is hypothesized that the relationship between experience quality and revisit intention is mediated by satisfaction. A self-administered structured questionnaire was used for data collection from a total of 250 respondents. Data was analysed with the use of SPSS, and correlation tests, linear regression tests, multiple hierarchical regression analysis, and Sobel tests were performed in order to test the hypothesis derived. The regression results revealed a significant relationship between experience quality and revisit intention. As per the results of multiple hierarchical regression analysis, it was evident that satisfaction is a mediator of experience quality and that it partially mediates between experience quality and revisit intention. The Sobel test was carried out in order to test whether the reduction created through the mediating variable is statistically significant. The Sobel test statistic is 44.0955 with a standard error of 0.0436 and it is significant at the 0.05 level. Hence, the mediation effect is significant. Results derived for the relationship between the independent variable (experience quality) and the dependent variable (revisit intention) revealed that satisfaction partially mediates the relationship between experience quality and revisit intention. Thus, the tourism specialist co-ops are encouraged to give careful consideration in the areas of controlling the experience quality to enhance the visitors' revisit intension.

Keywords: Experience quality, satisfaction, revisit intentions, tourism and Sri Lanka

E-mail: nishadirajapakshe@gmail.com

807/F

Identification of extension needs in tea processing: case of low country factories

M.K. Samaraweera[1]* and M. Wijeratne[2]

[1]Sri Lanka Tea Board, Kellegala, Nuwara Eliya, Sri Lanka
[2]Department of Agricultural Economics, University of Ruhuna, Sri Lanka

Sri Lankan tea is famous throughout the world as a beverage and it plays a major role in the country's economy. The tea industry is one of the important sectors as a foreign exchange earner (LKR 240.6 billion in 2019). It provides employment opportunities for 400,000 families. Even though research and extension efforts were launched in the past, the average national production of made tea remains at 2100 kg/ha/year. This is much below the potential yield of 3000 kg/ha/year. The tea processors convert green tea leaves to made tea through a complex process including withering, rolling, fermentation, drying, grading and sifting, expecting better prices at the tea auction. The tea factories are significantly responsible for quality tea production because the market prices are directly associated with tea quality. This study aims to identify the extension needs of the tea processors in the context of the tea processing sub-sector. The study selected 55 processors (factories) in Matara district, Sri Lanka and the field survey was conducted during January- June 2019. A questionnaire was used as the data gathering tool and check-lists and informal discussions were also incorporated. The factory managers were personally interviewed and their views on extension needs were obtained. Collected data were analyzed on non-parametric statistics and presented with tables and bar charts. The study identified nine issues encountered by the tea processors. Among them, four constraints, namely poor green leaf standards (82.7%), declining labour productivity (51.90%), limited technical knowledge on processing (19.2%) and unawareness to obtain extension services (13.2%) are extension issues. Therefore, extension agencies should implement programmes to remedy such conditions. The investigation reveals that tea manufacturing and marketing (42.59%), tea planting and leaf plucking (29.63%) and mechanization and certification (14.81%) are the most required training needs. Hence, extension service providers have to focus on training programmes to improve the knowledge and skills in the above fields. The tea processors use telephone for verbal communication (82.7%), internet (53.8%), SMS (50%) and mobile apps (26.9%) to communicate extension issues. The processors made suggestions to strengthen the tea industry by improving access to the potential markets (45.61%), provide more subsidies (17.54%), introduce new tea clones/cultivars (14.04%), provide awareness and training through proper extension and advisory services (12.28%) and improve existing infrastructure facilities (10.53%).

Keywords: Communication, dissemination, factories, extension, processors, tea, trainings

Email: mksamaraweera@yahoo.com

808/F

Drying technologies used in dried fish production in Sri Lanka: A review paper

J.A. Amanda * and D.N. Koralagama

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Quality, price and the income of dried fish production depends on the technologies used by the processors. Technologies have been developed to secure the keeping quality of dried fish including texture, color, smell, moisture content, appearance and some others. Besides technology needs to be cost effective in order to get attractive profit. This study attempts to explore different drying technologies available and used for dried fish production in different countries especially focusing on the Sri Lankan context. The systematic literature review technique was undertaken referring more than 58 articles. Available literature was downloaded through search engines of ScienceDirect, Google Scholar and Scopus. Key words including "dried fish", "drying", "techniques", "technologies", "quality", "cost effective" and "Sri Lanka "were used to search related articles and categorized accordingly. Solar tunnels are heavily used in countries like India, Bangladesh, Thailand and Indonesia. Modified dryers based on solar, biomass and hybrid versions and Improved rack systems are practiced in Kerala. Greenhouse type dryers are in Gujarat in India. Hybrid solar-biomass dryers have been introduced in Indonesia and Nepal. Heating techniques using mix of Hot Air Convection and Infrared Radiation for drying fish have been practiced in Thailand. Heat pump dryers and Vacuum dryers are popular in Norway and Western Europe respectively. In contrast, National Aquatic Resource Research &Development Agency (NARA) with National Engineering Research and Development Centre (NERD) have introduced improved fish dryer system in Sri Lanka. Further, drying decks have been introduced by Ministry of Fisheries and Aquatic Resource Development (MFARD) for dried fish producers in Sr Lanka. Despite the availability of advanced technologies, majority of dried fish producers in Sri Lanka adhere to primitive and conventional methods of sun drying using mats, gunny bags, ropes, racks and rock surfaces, which are not hygienically safe. However, literature also indicates the poor quality of the dried fish due to contaminants, spoilage, fungi growth, and losses occur due to rain and wastage. In conclusion, it is essential to explore the reasons for poor adaptation to the modern technology in terms of producing quality and hygienic product through cost-effective mechanism.

Keywords: Cost effective, dried fish, drying, quality, Sri Lanka, techniques, technologies

E-mail: ja.amanda715@gmail.com

809/F

Gender involvement and contribution for dried fish processing in Negombo

S.A. Adikary* and D.N. Koralagama

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna,
Sri Lanka

Male as well as female participation in dried fish production has increased employment opportunities in coastal areas. However, gender contribution and social relations within fishing communities are poorly researched. The focus of this study is to explore the gender involvement and their contribution in dried fish processing in Negombo, where one of the largest wholesale/retail dried fish market, Kamachchodaya, is located. Mixed method approach was adopted to glean data employing both questionnaire survey (n = 30) and in-depth interviews (n=10). The data was collected using qualitative data collection methods as well as quantitative data collection methods. Questionnaire survey was adopted drawing a sample of 30 dried fish processors randomly. Descriptive data analyze techniques were used for the analysis. In Negombo, there are approximately hundred medium- to small-scale dried fish processors, in which women make up about 65 percent of the workforce. Yet their involvement is highly dependent on the fish species. Processing steps of de-heading, gutting, de-scaling, washing, salting, rewashing, drying, and packing of small-pelagic fish spp. (eg: *Amblygaster leiogaster*, *Amblygaster sirm* and *Sardinella gibbosa*) are women dominated (90%). In contrast, processing of large pelagic (eg: *Katsuwonus pelamis*, *Carcharhinus sp.*and *Scomberoides lysan*) including de-heading, washing, salting, and rewashing raw fish and packing into cardboard boxes are dominated by the men. Sorting and grading are common activities for men and women. However, loading and unloading boxes to vehicles, transfer from processing centers to marketing centers, and packing are primarily done by men. Yet, payment disparities are recorded with a pay gap of LKR 300-500 for women compared to men. Production of dried fish is labor incentive; both men and women engage in a range of tasks. The primary producers of dried fish in Negombo are women. In contrast, Women's labor, has been discriminated against by paying a lower daily salary.

Keywords: Gender involvement, gender roles, contribution, dried fish

E-mail: anuupamaadhikari@gmail.com

810/F

An appraisal on patient's self-rule in light of medical informed consent law

A.P. Rathnayake

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

'Right to health' is considered as one of the fundamental rights in the world influencing all aspects of life. In the field of medicine, physicians ensure that patients are treated with dignity. The provision of standard care is of higher imperativeness. Basic objectives of this research focus on main entitlements of patients; namely, the right for access to information, clear disclosure and the right for informed consent. 'Right for informed consent' emphasizes the fact that, patients have the freedom to make decisions. The patient's power of decision making is respected by the physicians. The author focused on the development of patient-physician relationships. The medical paternalism signifies that, physicians are the sole decision makers on behalf of the patient. With the passage of time, the paternalistic relationship was overridden by the informative relationship between the patient and the physician. The informative relationship upholds the status of the patient where the physician is in the position to provide sufficient information which simultaneously prioritize the patient's autonomy. In *Canterbury v. Spence*, it was held that the physician is bound to disclose key pieces of information. 'Informed consent' is a process which educates the patients to understand the benefits, risks and alternatives. The exercise of the right to informed consent enables a patient to make a voluntary decision and exceptions have been introduced on justifiable grounds. In addition to this, the stance on children is differently considered due to the incapacitated nature. The problem is existing whether the development of doctor-patient relationship has caused a substantial impact on the medical informed consent law. The research identifies three main legal approaches as standards of informed consent; namely, 'subjective standard', 'reasonable patient standard' and 'reasonable physician standard'. The author has adapted a qualitative approach to the methodology and the predominantly used primary and secondary sources of law to support the content analysis. The conclusion of the research significantly addresses the importance of patient's autonomy in the process of decision making related to medical matters and the positive influence of deliberative, interpretative and informative patient-physician relationships in the recognition and improvement of patient rights.

Keywords: Patient, autonomy, informed consent, patient-physician relationship

Email: ayodhyarathnayake7@gmail.com

811/F

Do vaccine mandates sabotage human physical integrity? A legal analysis

A.P. Rathnayake

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

The recent outbreak of the global pandemic resulted in the development of controversy related to mandatory vaccines. The outcome of a vaccine mandate resembles two sides of the same coin whereas it predominantly epitomizes the ethics of public health and the subject's right to privacy, autonomy and liberty. Utilitarian perspective on the controversy emphasizes the fact that vaccine mandates ensure higher immunization and results in positivity and good health to all lives. Universal vaccination is preferred due to certain justifications; namely, community protection and reduction in virus transmissions. A vaccine mandate has advantages in the context of medical ethics including beneficence, non-maleficence and justice. The obligations on the part of a medical community are of two facets where they have both legal and moral obligations. Having considered all the positive outcomes of vaccine mandates, the common problem in existence is the collision between human physical integrity and universal vaccination. One of the foremost obligations on the part of the medical community is the assurance of a safe environment to the public. Distributive justice mainly considers the treatment of patients equitably. The notion of the medical community that vaccine mandates imposed on the public without consensus have the possibility of rescuing them from the negative effects of external constraints. External constraints are quarantine and lockdowns which negatively affect the mental health of people. As the Fourteenth Amendment to the Constitution of United States asserted that no state shall make or enforce any law curtailing a person's life, liberty and property without the due process of law, scholars' opinion is that compulsory vaccination is an affront to the bodily integrity of humans. The author in this research has adapted a content analysis followed by the qualitative approach. The analysis was supported by primary and secondary sources of law. The author has predominantly used an illustrative jurisdiction, the European legal framework. In this research, the author focusses on the benefits of universal vaccination, the legal perspectives on vaccine mandate and the manner in which the European Court of Human Rights define the nature of vaccine mandates.

Keywords: Vaccine mandate, physical integrity, beneficence, medical ethics

Email: ayodhyarathnayake7@gmail.com

Poster Presentations

901/A

A review of pharmacological actions of medicinal plants as a polyherbal formulation – Agraraja Kwatha

S.M.D.N.P. Senaratna [1]* and Y.A.U.D. Karunarathne[2]

[1]*Postgraduate Institute of Indigenous Medicine, University of Colombo*
[2]*Institute of Indigenous Medicine, University of Colombo*

Uterine fibroids are the most common benign tumors that arise from the myometrium of the uterus during the reproductive age. As a result, between 25%–50% of women with fibroids receive surgical treatment, namely myomectomy or hysterectomy. It is estimated that at least 20% of women aged 35 develop fibroids. As they are seen during prime working years, they negatively affect women's ability to work. Symptomatology like heavy bleeding, pain in abdomen, back pain *etc.* interfere with the social, professional and mental wellbeing of women. There are many allopathic drugs and surgical procedures available. However, these may cause side effects, are costly and result in economic pressure. The objective of this review is to summarize the available information on the mechanism of various plant ingredients in poly herbal formulation, which inhibit the uterine fibroid activity and decrease symptoms related to this condition. A systematic search was performed of literature. A poly herbal drug consists of nearly 12 medicinal plants, which include cheenaroot *(Smilax glabra Roxb)*, Kohomba *(Azadirachta indica juss),* Kaluduru *(Nigella sativa Linn),* Suduru *(Cuminum cyminum),* Enasahal *(Elettaria cardamomum Maton),* Kurudu *(Cinnamamum zelanicum blume)* Sarana *(Boehaavia difffuss Linn.)* Inguru *(Zingiber offinale),* Gammiris *(Piper nigram Linn)*, Titpili *(Pipper longum Linn),* Asamodagam (*Carum copticum Bentha Hook*) and Kottamalli *(Coriandrum sativum).* However, six ingredients were included and discussed, which yields useful information regarding the mechanism of different botanical drugs for patients who are interested in conservational treatment for uterine fibroids. In conclusion, poly herbal formula contained phytochemicals, antioxidants, antimicrobials, and has antitumor, anti-inflammatory, immunomodulatory and hepato-protective activities, improves quality of life and is an effective drug for managing symptoms of uterine fibroid and its complications.

Keywords: Uterine fibroid, Agraraja Kwatha, pharmaceutical properties

E-mail: nirmala.senaratna@gmail.com

902/A

Development of an educational e-resource including dietary menus for adults with coronary artery disease (CAD) and adults at risk of CAD

K.D.S.P.N. Kathriarachchi and A.M.N.T. Adikari*

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

Coronary artery disease (CAD) is one of the most prevailing non-communicable diseases in the world. Dietary modification is an effective strategy to manage this global burden. Identification of dietary intake and provision of heart-healthy dietary menus for adults with CAD and at risk of CAD would improve their quality of life. The objectives of this study were to identify the dietary patterns, food preferences, and current dietary intake of CAD patients and adults at risk of CAD and develop an educational e-resource including dietary menus for CAD. A cross-sectional study was carried out including conveniently selected 15 CAD patients from Kandy hospital and 15 adults at risk of CAD from a selected area in Badulla district. An interviewer administered questionnaire (IAQ), food frequency questionnaire (FFQ), and 24-hour dietary recall was used for data collection. Mediterranean and dietary approaches for stop hypertension (DASH) dietary guidelines were used to prepare seven whole-day dietary menus, including breakfast, lunch, dinner, and snacks. The nutritional composition of developed menus was analyzed by FoodBase 2000 software, which includes nutrient composition of Sri Lankan foods and recipes. The adequacy and the acceptability of the developed menus were tested by giving prepared menus to five CAD patients and five adults at risk of CAD. Daily mean energy requirement and intake of carbohydrate, protein, and fat of the study sample were 2024.6 ± 162.2 kcal, 57.9±10.7 g, and 54.7±17.3 g and 247.7±45.7 g, respectively. The majority of participants preferred rice, used coconut oil, and ate meat and egg than fish. Their fruit and vegetable consumption were based on the availability and accessibility. The developed seven menus' energy ranged from 1100 to 1700 kcal and included heart-healthy commonly available food. The planned menus were compiled into an e-resource (blog) with serving sizes showing photos. Pre-testing of developed menus showed that the majority accepted the menus, were satisfied with the portion size, and agreed to abide by them. The developed e-resource (blog), which includes dietary menus may be helpful to reduce the progression of CAD in Sri Lanka.

Keywords: Coronary artery disease, dietary patterns, dietary intake

E-mail: namalithakshila@wyb.ac.lk

903/A

Pharmacological effects of *Sesamum indicum*; A systematic review

S.H.K. Deepthika[1]*, K.P. K. R. Karunagoda[2] and P.K. Perera[3]

[1]Department of Kaumarabritya and Stree Roga, Faculty of Indigenous Medicine, Gampaha Wickramarachchi University of Indigenous Medicine, Sri Lanka
[2]Unit of Prasutitantra Kaumarabhritya, Institute of Indigenous Medicine, University of Colombo, Sri Lanka
[3]Institute of Indigenous Medicine, University of Colombo, Sri Lanka

Sesamum indicum L. is one of the world's oldest oilseed crops. There are three varieties of sesame, red, white and black. *Sesamum indicum* is a widely used medicine in Ayurveda in Sri Lanka. The stalk, leaves, seeds, and oil of *Sesamum indicum* have medicinal values. A systematic search of previously published research articles was conducted in PubMed, Scopus, and Cochrane library databases for studies published between January 2011 and May 2022. We considered the PRISMA statement to provide a good structure. The keywords used to search for articles included "*Sesamum indicum.*" Other filters were selected to limit the search to medicine, open access, full-text articles, journal articles, and English articles. All relevant articles were gathered from databases in the first stage. In the second stage, all articles found by searching the databases were pooled, and duplicate articles were removed. The remaining papers were screened by reading the titles and abstracts with the most relevant articles chosen. In the last stage, chosen articles were reviewed again by reading the entire article, and those that did not meet the inclusion criteria were eliminated. A manual search was conducted to collect additional data. Information related to the pharmacological activity, type of extract used, part, test method, laboratory organism/animal used were gathered. Using the above-mentioned search parameters, the following number of research articles were found; PubMed (n = 03), Cochrane library (n = 39), and Scopus (n = 75). After removing duplicates, there were 114 articles which were further screened and those that did not match were removed. After removing those articles there were 27 articles and after adding 03 additional articles finally, 30 articles were included in the systematic review. Finally, 08 clinical trials, 11 *in vivo*, and 15 *in vitro* research were analyzed. According to those studies, its anti-cancer activity, antioxidant activity, antibacterial activity, antiatherosclerosis activity, anti-inflammatory activity, analgesic activity, anti-allergic activity, menstrual bleeding inducing effect, skin whitening effect, neuroprotective activity, *etc.* had been proven scientifically.

Keywords: *Sesamum indicum*, pharmacological effect, systematic review

E-mail: krishanid@kln.ac.lk

904/A

Methylenetetrahydrofolate reductase gene polymorphisms and its implication in various health conditions: A review

A. Chandrasekaran* and G.H.R.E. Karunaratne

Faculty of Science, Horizon Campus, Malabe, Sri Lanka

Methylenetetrahydrofolate reductase (MTHFR) is a vital enzyme in folate metabolism, which is encoded by the *MTHFR* gene. The two most common single nucleotide polymorphisms found in *MTHFR* gene are the C677T and A1298C, which leads to reduced activity of MTHFR enzyme. Defective enzyme causes impairments in the folate metabolic pathway leading to several health complications and increased susceptibility to several health disorders. Several studies have been conducted to study the association between *MTHFR* polymorphism and different disease conditions. However, the results of most studies are inconsistent. This review was done to provide comprehensive knowledge on the association between *MTHFR* polymorphism and selected health conditions such as autism, rheumatoid arthritis, migraine, breast cancers, psychiatric disorders and pregnancy complications. Forty-five studies conducted from 2005 to 2021 were included. Studies related to *MTHFR* polymorphism in different ethnic groups, meta-analysis and case studies were collected using keywords such as "*MTHFR* polymorphism", "C677T", "A1298C" and "folate metabolism" and analysed systematically. The results revealed that the C677T polymorphism was widely implicated with these health conditions compared to A1298C. The C677T polymorphism increased the risk of autism, rheumatoid arthritis, migraine, pregnancy complications and psychiatric disorders while both C677T and A1298C *MTHFR* polymorphisms equally increased the risk of breast cancer. The two polymorphisms lead to breast cancer mainly *via* abnormal DNA methylation and lead to the other afore mentioned health conditions due to elevated homocysteine levels. It can be suggested that folate supplementation might be used to reduce the susceptibility of these conditions in polymorphic individuals. This study also identifies the prevailing knowledge gaps, thus by doing extensive research on *MTHFR* polymorphisms, its role on the etiology of these conditions can be better understood. Thereby, this information would help in developing more specific and improved treatment approaches for these conditions. Further research should also focus on optimizing MTHFR enzyme activity in individuals with polymorphic alleles.

Keywords: MTHFR, folate, C677T, A1298C, homocysteine

E-mail: chandrasekarana@horizoncampus.edu.lk

905/A

Antidiabetic potency of family Aristolochiaceae: A review

K.H.R.L.G. Piyathilaka and G.H.R Eranga Karunaratne

Faculty of Science, Horizon Campus, Malabe, Sri Lanka

The plant species in the family Aristolochiaceae consist of various important bioactive compounds, and they are used as functional ingredients in the development of therapeutic agents to act against diseases including diabetes. This review focuses on identifying the glucose-lowering potencies regarding the diabetic mellitus of plant species in the family Aristolochiaceae. This was done by conducting literature research between the years 2008 to 2020 using the database Google Scholar and PubMed. A total of 56 articles were studied to analyze data, 13 articles were included in the report, and 43 articles were excluded. This review mainly focuses on the alpha-glucosidase inhibition in alpha-glucosidase inhibitory assay, alpha-amylase dehydrogenase rate in alpha-amylase inhibitory assay, and glucose reduction in the diabetic rat model. In the diabetic rat model, root ethanolic extract of *Aristolochia ringens* showed the highest glucose reduction with the Streptozotocin (STZ) diabetogenic agent, which is 113.1±1.8 mg/dL. The ethanol extract of *Aristolochia indica* leaves showed the highest glucose reduction with the alloxan diabetogenic agent, which is 5.28±0.37 mg/dL. When using dexamethasone as a diabetogenic agent, methanolic extract of the whole plant of *Aristolochia bracteolata* showed the highest glucose reduction which is 124.5±1.231 mg/dL. In α-glucosidase inhibitory assay, ethyl acetate root extract of *Aristolochia longa* showed the highest IC50 value which is 0.199±0.014 mg/mL. In the α-amylase inhibitory assay, whole plant methanolic extract of *Aristolochia indica* showed the highest α-amylase dehydrogenase rate, which is 60.12 ±0.46 nmol/min/mg protein. The genus *Aristolochia* in the family Aristolochiaceae was showed significant diabetes potency. The attention should be given to other genera to be tested for their potential to act against diabetes. Moreover, the importance of using species in the family Aristolochiaceae in the management of diabetes should be identify and accept to suitable alternative medicines in future studies.

906/A

Risk factors of central obesity and the percentage of central obesity among myocardial infarction patients with normal body mass index

G.G.P.S. Rathnasiri and A.M.N.T. Adrikari*

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

Central obesity is an independent risk factor and a better predictor of myocardial Infarction (MI) than general obesity determined by the body Mass Index (BMI). Since a higher mortality rate was found among normal BMI patients with Central Obesity (CO), this study sought to determine the risk factors of CO and identify the percentage of central obesity among MI patients with normal BMI. MI patients who were admitted to a private hospital in Colombo during a one-month period from August to September 2021 were recruited as the sample. Height and weight measurements, and nutrition-related information were collected using the assessment forms of the dietitian. Dietary information was collected using a pretested interviewer-administered questionnaire. Self-measured waist circumferences (WC) were collected from the patients by providing a video with instructions. WHO cutoff values for Asians were used to determine the patients with normal BMI ($18.5\text{-}22.9 \text{ kg m}^{-2}$) and WC > 90 cm for males; >80 cm for females were used to identify central obesity. Statistical analysis was performed using SPSS version 16.0 statistical software package. A total of 30 MI patients' mean age was 60.03 ± 13.12 years and the majority (83%) were males. The mean height, weight, BMI, and WC of the sample were 163.8 ± 8.45 cm, 65.2 ± 10.59 kg, $24.3\pm3.53 \text{ kg m}^{-2}$, and 89.6 ± 10.89 cm, respectively; (Male; 165.3 ± 8.33 cm, 66.3 ± 10.90 kg, $24.3\pm3.46 \text{ kg m}^{-2}$, 91.6 ± 9.73 cm, Female; 156.2 ± 3.96 cm, 59.7 ± 7.40 kg, $24.4\pm2.94 \text{ kg m}^{-2}$, 79.6 ± 11.92 cm). Out of the total 30 patients, 15 patients had central obesity (50%). Only 9 (30%) were in the normal range of BMI and 4 patients (44.4%) had central obesity. High consumption of starchy food ($p=0.009$); low consumption of vegetables ($p=0.000$); high consumption of sugar ($p=0.025$); low frequency of consuming fish ($p=0.009$); skipping breakfast ($p=0.035$) were risk factors for central obesity of the study sample. Results revealed an association between alcohol consumption and central obesity ($p=0.035$). Further studies on MI patients are required to get a clear understanding of central obesity among Sri Lankan MI patients.

Keywords: Body mass index, central obesity, myocardial infarction, risk factors

E-mail: namalithakshila@wyb.ac.lk

908/B

Antioxidant capacity, chemical constituents and essential oil content in different parts of *Alpinia galanga* Willd and *Alpinia calcarata* Roscoe

N. Bista[1], D.C. Abeysinghe[1]*, R. M. Dharmadasa[2] and I.J. Amadoru[1]

[1]Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka
[2]Industrial Technology Institute, 363, Bauddhaloka Mawatha, Colombo 07, Sri Lanka

Alpinia galanga and *Alpinia calcarata* are two important medicinal plant species of the genus *Alpinia* (Family: Zingiberaceae) widely found in tropical climates, which are having a diverse therapeutic value in treating headache, sore throat, chest pain, skin diseases and stomach disorders. The objective of the present work was to determine bioactive compounds, antioxidant capacity, essential oil content and proximate composition in different parts of *A. galanga* and *A. calcarata.* Samples (n = 20) consisting of three replicates were collected from medicinal home garden of Industrial Technology Institute (ITI), Malabe. Total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) were determined using the Folin-Ciocalteu method, colorimetric method and ferric ion reducing antioxidant power (FRAP) assay, respectively. Essential oil content in different plant parts (leaf, leaf sheath, rhizome, fibrous root and flower) was determined by using the hydro-distillation method whereas proximate composition (moisture, ash and fat) was determined according to the Association of Official Analytical Chemists (AOAC) method. The highest TPC (15.37 ± 0.21 and 10.13 ± 0.55 mg gallic acid equivalents/g dry weight), TFC (218.22 ± 13.88 and 149.97 ± 3.77 mg rutin equivalents/g dry weight) and TAC (105.37 ± 4.92 and 57.27 ± 0.64 mg Trolox equivalents/g dry weight) were observed in flower, followed by leaf, leaf sheath, fibrous roots and rhizome in both *A. galanga* and *A. calcarata.* Significantly higher essential oil content was observed in the fibrous roots (1.89% ± 0.07 and 1.61% ± 0.07) in comparison with leaves, leaf sheath and rhizome in both species. Higher ash content was observed in leaves of both *A. galanga* (5.06% ± 0.12) and in leaves of *A. calcarata* (5.00% ± 0.2) whereas higher crude fat was observed in the fibrous roots of both *A. galanga* (1.62% ± 0.15) and *A. calcarata* (1.6% ± 0.17). According to the results, it could be concluded that *A. galanga* and *A. calcarata* produced a wide spectrum of phytoconstituents that may be responsible for a variety of bioactivities. These discoveries may provide a new route for future pharmaceutical research.

Keywords: *Alpinia*, bioactive compounds, essential oils, total antioxidant capacity

E-mail: abeysinghedc@yahoo.com

909/B

Identification of the adaptable Beet (*Beta vulgaris*) varieties for reduced nitrogen under *in vitro* conditions

A.S. Jathunarachchi, B.U.C. Batangala, D.R. Gimhani and P.I.P. Perera*

Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka

Nitrogen (N) is an essential nutrient required for the growth and development of crops, which ultimately affects yield potential. It is one of the major elements in the structural, genetic and metabolic composites in plants. However, excessive application of N fertilizers causes a negative environmental impact and increases the cost of production. Crops cultivated in sandy regosol soil in Kalpitiya region are liable to nitrate leaching, leading to groundwater contamination and influencing human health. Therefore, long-term sustainable approaches are required to overcome this problem. In order to practice environmentally friendly sustainable agriculture, cultivars have to be screened which can tolerate low N levels with high utilization efficiency. Hence, the present study was conducted to screen three commercially grown beet varieties (Red atlas, Royal red, Maravilla andina) for low N under *in-vitro* conditions. The experiment was arranged in a two-factor factorial completely randomized design using thirty germinated seedlings per treatment. Seedling characteristics include the number of leaves, number of roots, shoot length, root length, and dry weight recorded at the end of 30 days of sub culturing under four N levels, supplemented in half-strength Murashige and Skoog (MS) media. The four tested N levels were 875 mg/L (control), 656.25, 437.5 and 218.75 mg/L of NH_4NO_3. The recorded data were subjected to Analysis of Variance and mean separation was done using least significant difference. Each variety performed differently for the tested N levels. Maravilla andina showed a comparable performance at all the nitrogen levels for all the parameters. It revealed the tolerance of the Maravilla andina variety under reduced N level. The Red atlas showed a higher sensitivity for the tested N levels by showing significant reductions for all the parameters except the dry weight of the plant. In Royal red, a significant difference was not observed in the number of roots, shoot and root length in all the tested N levels. However, a significant increase was observed in plant dry weight. Therefore, Maravilla andina was identified as the most tolerant genotype among the tested three varieties and selected for evaluating the yield performance under field conditions.

Keywords: Adaptable varieties, *in vitro* screening, MS medium, tolerance to reduced nitrogen

E-mail: prasanthi@wyb.ac.lk

910/B

Effect of selected probiotic strains in fermentation stage on bioactive properties of low country black tea

H.S. Liyanage and R.A.U.J. Marapana*

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Microbial fermented tea is an emerging area in food industry. Kombucha, Pu-erh tea, Fu brick tea and Miang tea are some of the fermented tea varieties especially popular in Southeast Asian countries. Acetic acid bacteria, lactic acid bacteria, yeast and fungi are commonly found microbes used in fermented tea production. Tea fermentation with microorganisms is getting popular recently due to their sensory properties and increased benefits. This study was carried out to evaluate the effect of selected probiotic organisms in the fermentation stage of Low country grown black tea. Yeast (*Saccharomyces cerevisiae*), thermophilic lactic acid bacteria *(Lactobacillus bulgaricus* and *Streptococcus thermophiles*) and 1:1 mix of two of above cultures were used as the microbial cultures and fermentation was allowed at room temperature (25 °C) and 43 °C, separately. The samples were tested for total phenolic content (TPC), total flavonoid content (TFC) and antioxidant content. Results were analyzed using 3×2 multilevel factorial design as the experimental design. All the fermented tea samples showed an increment in TPC, TFC and antioxidant content compared to unfermented tea. TPC, TFC and antioxidant content of fermented tea ranged between 243.98±15.27 − 416.33±3.83 mg GAE/L, 192.63±18.66− 282.76±0.45 mg QE/L and 1287.00±53.92 − 2833.13±56.68 mg AAE/L, respectively. Fermentation culture, temperature, and their interaction had a significant effect ($p<0.05$) on TPC and antioxidant content, but the effect of fermentation culture was not significant ($p>0.05$) on TFC of fermented tea. Tea fermented with yeast showed decrement in TPC, TFC and antioxidant capacity with high temperature. Lactic acid bacteria (LAB) fermented tea showed increments in TPC and antioxidant content and decrement in TFC with the increment of temperature. Tea fermented with mix culture showed increments in TPC and TFC while reduction in antioxidant activity in high temperature. Tea fermented with yeast at room temperature showed the highest values for TPC (416.33±3.83 mg GAE/L) and antioxidant capacity (2833.13±56.68 mg AAE/L) and the highest TFC was obtained in tea fermented with mix culture at 43 °C temperature (282.76±0.45 mg QE/L). According to the results, it can be concluded that microbial fermentation can have a significant effect on the bioactive properties of tea and the degree of effect vary with fermentation culture and temperature.

Keywords: Antioxidants, fermented tea, flavonoids, lactic acid bacteria, polyphenols, yeast

E-mail: umarapana@sci.sjp.ac.lk

911/B

Effect of stabilization thermal treatments on extractability, oxidative stability and antioxidant activity of rice bran oil of the variety "Ld 368"

D.S.U. Aluthge and K.K.D.S. Ranaweera*

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Rice bran is the cuticle layer between the paddy husk and the endosperm, a nutritious underutilized byproduct of rice milling. Stabilization is essential in preventing the oxidation of lipid in the bran as it inactivates the endogenous enzymes. This study was conducted to determine the effect of stabilization on the oil extractability, oxidative stability, and antioxidant potential of rice bran oil. Freshly milled rice bran samples of the variety "Ld 368 - red" were collected for this study as it is a generally grown cultivation. The rice bran samples were stabilized using the following pretreatments including, steaming (100 ⁰C, 30 minutes), hot air drying (105 ⁰C, 1 hour), microwave (900 W, 3 minutes), and coupled treatment (microwave and steaming). Unstabilized rice bran was used as the control in this study. Extraction of rice bran oil was conducted by solvent extraction method. The highest extraction yield (22.26%) was obtained from the rice bran stabilized by coupled treatment, followed by microwave drying (19.02%), steaming (18.93%), and hot air drying (17.07%). Stabilized rice bran under the four treatments showed a significantly low free fatty acid and peroxide value compared to the unstabilized rice bran ($p < 0.05$). The coupled treatment and microwave treatment were the most effective stabilization pretreatments of rice bran in terms of oxidative stability, as it showed the lowest free fatty acid content (2.95% and 2.99%) and peroxide value (0.518 and 0.620 meq/kg oil). There was a significant difference of antioxidant activity of rice bran oil obtained from stabilized and unstabilized rice bran samples ($p < 0.05$). Microwave drying is the most effective method in terms of preserving antioxidants in bran oil as it exhibited the highest antioxidant activity.

Keywords: Antioxidant activity, oil extractability, oxidative stability, rice bran oil, stabilization

E-mail: sranaweera@sjp.ac.lk

912/B

Development of pasteurized grain-milk beverage and evaluation of physicochemical and sensory properties

L.A. Wickramarachchi[1], H.M.T. Herath[2*], D.U. Rajawardene[2] and M. Jayasinghe[1]

[1]Department of Food Science & Technology, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Food Technology Section, Modern Research and Development Complex, Industrial Technology
Institute, 503A, Halbarawa Gardens, Malabe, Sri Lanka

Consumer demand for nutritious and healthy foods is in continuous rise during the past two decades. The aim of this study was to develop a low fat, gluten free functional grain-milk beverage with improved nutritional and flavor profiles. Grain mixtures were prepared by mixing selected grains of sorghum, horse gram and red rice 'kuruluthuda' at three grain ratios of 5:2:3, 3:4:3 and 4:5:2. Grain extract was prepared by optimizing the processing steps of soaking overnight, pressure cooking, blending with water (1:3) and filtering. The best ratio of grain mixture (5:2:3) was selected based on primary sensory evaluation. Formulation of grain-milk beverages was performed in three different grain extract ratios (60%, 65% and 70%) with cow's milk, sesame milk, sweetener (Kithul treacle and sugar) and carrageenan followed by homogenizing (6000 rpm) and pasteurizing (at 85 °C for 30 min). The 70% multi-grain extract containing sugar and treacle beverages were selected as the best formulations based on sensorial attributes in terms of appearance, color, mouth feel, sweetness, overall taste and overall acceptability. The physical, chemical and sensory properties were measured and analyzed statistically using SPSS software. The total soluble solid, titratable acidity and pH of the pasteurized beverage with sugar and treacle were ($13.23\pm0.06\%$; $13.40\pm0.1\%$), ($0.01\pm0.00\%$; $0.02\pm0.00\%$) and (6.11 ± 0.01; 5.8 ± 0.00), respectively. Proximate composition of fat, protein, crude fiber, total ash, carbohydrate and caloric value of beverages containing sugar and treacle were ($1.42\pm0.05\%$; 2.35 ± 0.01), ($1.58\pm0.04\%$; $1.48\pm0.04\%$), ($0.46\pm0.05\%$; $0.49\pm0.02\%$), ($0.34\pm0.00\%$; $0.35\pm0.00\%$), ($13.20\pm0.00\%$; $12.26\pm0.01\%$) and (74.60 kcal; 74.57 kcal), respectively. Trypsin inhibitory activity of sugar and treacle grain-milk beverages were 0.32 ± 0.01 mg/g and 0.38 ± 0.04 mg/g, respectively. There was a significant difference ($p<0.05$) among the two samples in terms of protein, fat and carbohydrate percentages and trypsin inhibitory activity values. After adding potassium sorbate as a preservative, the shelf life of pasteurized sugar incorporated grain-milk beverage was 14 days while that of Kithul treacle incorporated grain-milk beverage was 11 days as determined by the yeast and mould microbial total plate count and sensory analysis. The result obtained from the study reveals it was feasible to combine the grain extracts and cow's milk to create a value-added beverage. Furthermore, developed beverages have a high potential to be introduced to the local market as healthy beverages.

Keywords: Grain-milk beverage, healthy beverage, horse gram, red rice, sorghum

E-mail: theja@iti.lk

913/B

Adopting a low-cost sterilization method for *in vitro* clonal multiplication of Turmeric *(Curcuma longa)*

A.G.B. Aruggoda* and H.G.A. Kumudumali

The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Micro propagation is a novel method of plant propagation, which uses small pieces of plant tissues to produce a number of new plants that are same as the mother plant, and the technique involves a careful preparation method under laboratory conditions. *Curcuma longa* is a monocot, herbaceous plant and a well-known spice commonly called as turmeric, is cultivated for different aspects. The plant cannot be grown easily throughout the year, and the recent government import restrictions have created a huge demand for turmeric. The purpose of this study was to micro propagate turmeric rhizome using a new protocol. The new protocol involves an *in-vitro* regeneration of explants with the best suitable low-cost surface sterilization method and preparation of a new media using different hormone combinations with different concentrations of cytokines and auxins. In this study, two separate experiments were conducted. The first experiment was on surface sterilization method, which included 20 treatments and the second experiment was for media preparation, which had 12 treatments of hormone combinations with 6 replicates. All media were autoclaved at 121 °C to avoid contaminations. The study was successfully conducted with the growth hormones under 16 hours photoperiod. *In-vitro* rhizome formation was observed in media containing 30 g sucrose. Shoot induction started from the rhizome buds and the study was carried out in the Murashige and Skoog media, a combination of 2.5 mg/L of Kinetin and 1 mg/L of indole butyric acid. The medium was optimized for rapid clonal shoot initiation and the results were similar in media of 3 mg/L of Kinetin with 0.5 mg/L of naphthaleneacetic acid. The statistical analysis revealed that there was a significant variation in shoot length. The performance of the explants in terms of number of shoots, leaf length, shoot length and survival percentage assured that the new protocol can be recommended for turmeric propagation.

Keywords: *Curcuma longa*, *in vitro* propagation, sterilization method, protocol

E-mail: achala.12yv@gmail.com

914/B

Impact by value-added coconut (*Cocos nucifera L.*) jaggery on their glycemic indices

H.P.D.T. Hewa Pathirana[1]*, I. Wijesekara[2], L. L. W. C. Yalegama[1] and M.A. Jayasinghe[2]

[1]*Coconut Processing Research Division, Coconut Research Institute, Bandirippuwa Estate, Lunuwila, Sri Lanka*
[2]*Department of Food Science & Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

Diet plays an important role in the occurrence and severity of non-communicable diseases such as type 2 diabetes. Hence, consumer awareness of low sugar-containing food intake has increased. This study aims to determine the glycemic index (GI) of different types of coconut jaggery prepared from traditionally collected coconut sap with hal (*Vateria copallifera*) bark (HAL Jaggery), value-added coconut jaggery made with 0.2% cinnamon (*Cinnamomum zeylanicum;* CIN Jaggery) and 0.05% nutmeg (*Myristica fragrans;* NUT Jaggery) using healthy subjects. The total starch, resistant starch, and digestible starch content of each type of jaggery were analyzed. Twenty-one healthy volunteers (female: 9 and male: 11) aged between 20 to 40 years were recruited, and health screening tests were done. The postprandial blood glucose concentration was measured after intake of 50 g carbohydrate-containing food sample, after fasting for 8 to 12 hours, while keeping one week gap between each sample using randomized crossover design. Glucose was used as the standard. Intravenous blood samples were collected by antecubital fossa to analyze the glucose concentration. The area under the glucose response, the dependent variable, was analyzed using ANOVA at the significance level of 0.05. The Initial screening results showed that the subjects have healthy limits of fasting blood glucose concentration (98.23±9.10 mg/dL) and a simple blood test that measures the average blood sugar levels over the past 3 months (HbA1c) (4.83±0.33%). The total and digestible starch percentages were similar in three types of jaggery, but significantly higher ($P<0.05$) resistant starch content was observed in HAL Jaggery (0.45±0.05%). There was no significant ($P>0.05$) difference between the peak value of glucose concentration for three types of jaggery, where they were 143.33±12.61, 153.07±15.25 and 145.13±22.39 mg/dL, respectively in HAL, CIN and NUT jaggery types. A previous study has proven that glycemic index of coconut sugar is 56±3.6 (medium GI food). The results of this study confirmed that the GI of HAL (55.79±20.36), NUT (57.56±22.95) and CIN (59.45±20.36) jaggery was not significantly different, and all three types can be categorized as medium GI sweeteners.

915/B

Development of concentrated herbal tea based on refuse tea, BOPF, and dust 2 tea grades incorporated with *Pimenta dioica* (Allspice), *Mentha spicata* (Mint), and *Zingiber officinale* (Ginger)

R.M Dharmadasa[1]* and B.P.A. Imesha[2]

[1]Industrial Technology Institute, Colombo 7, Sri Lanka
[2]Uva Wellassa University, Badulla, Sri Lanka

Despite the fact that Sri Lanka is one of the largest tea (*Camellia sinensis*) exporters in the world, the country still exports much of its tea in the bulk form without significant value addition. Therefore, any effort to add value to tea could yield better revenues for the country. Accordingly, the focus of the present study is on developing a concentrated tea, with three unique flavor fusions; *Pimenta dioica*, *Mentha spicata*, and *Zingiber officinale*. These spices contain a plethora of bioactive molecules with potent antioxidant and therapeutic effects. For the study, refuse tea, BOPF and Dust 2 grades were used to develop the tea base and it was incorporated with the studied flavor fusions. Initially, the amounts of ingredients were optimized according to the preliminary sensory evaluation. Hot extraction (simple boiling) method was used to extract the tea samples. Sugar was added and macerated until it reached a final concentration of 30-40 °Bx. Dried allspice leaves (4%), fresh ginger (32%) and mint (24%)) were added and kept in less than 40 °C for 10 minutes. Then the concentrated herbal tea was filtered and bottled following refrigeration at 4 °C. Organoleptic, physicochemical characteristics and shelf life of the tea samples were tested and the data were analyzed using Friedman test and one way ANOVA at 5 % significance level using Minitab software. As per the results, sensory attributes like mouth feel, overall taste, and overall acceptability depicted a significant difference between the grades while no significant difference was observed in appearance, color and aroma. The concentrated herbal tea based on BOPF grade was selected as the most preferred sample. Proximate parameters such as carbohydrate content and energy indicate significant difference within the studied grades ($P< 0.05$) and high values observed for BOPF grade (33.5% and 135 kcal/100 mL). Physicochemical characteristics such as viscosity, color, antioxidant capacity, total flavonoid content depicted significant difference within the three tea grades ($P < 0.05$). In conclusion, unique flavor combinations provided a pleasant sensorial experience to concentrated tea while the tea grades used directly impacted on the end quality of the product.

Keywords: BOPF, concentrated tea, dust 2, refuse tea, spices

E-mail: aki123imesha456@gmail.com

916/D

Characterization and validation of kerosene degradation potential of selected bacterial isolates from petroleum contaminated soil samples in Sri Lanka- a preliminary study

A.M. Weerakoon[1]*, P.S. Wanigasooriya[1,2] and S.R. Karunaratne[2]

[1]*School of Applied Sciences, Edinburgh Napier University (ENU), Edinburgh, Scotland, UK*
[2]*Spectrum Institute of Science and Technology (SIST), Sri Lanka*

Petroleum hydrocarbons are considered an important energy source that is used by industries and in our daily life; however, over-usage of petroleum products has shown deleterious effects on the environment. Petroleum contamination is a result of both natural and human activities such as terrestrial and freshwater run-off, accidental spillage of petroleum products during transport, leaking above ground and in underground storage tanks and from industrial processes. Some microorganisms are capable of surviving in these harsh environments by utilizing petroleum-pollutants as their sole source of carbon, therefore bioremediation is considered as a promising technology for the removal of hydrocarbon-contaminants from soil. The main aim of this study was to validate the kerosene degradation potential of bacteria isolated from petroleum-contaminated soil collected from the Kolonnawa Oil Installation plant in Sri Lanka. A total of 9 isolates, 7 were from petroleum-contaminated soil and 2 isolates were directly isolated from petrol and kerosene. The kerosene degradation potential of the isolates was assessed using a redox indicator dye 2,6-Dichlorophenolindophenol and oxidation levels were determined by spectrophotometry, which directly correlated to the efficacy of hydrocarbon degradation. Statistical analyses were performed using Rstudio version 4.0.2 and OD values from the 2,6-DCPIP assay were analyzed using the Kruskal-Wallis test and Dunn's test. Results revealed that all the isolates were able to effectively utilize kerosene as the sole source of carbon, indicating their ability to degrade hydrocarbons. Isolates K10 (44.44%) and B6.2 (43.19%) exhibited the highest oxidation rates for kerosene. A highly significant difference in absorbance values for all 9 isolates was observed between day 0 and day 7 in the 2,6-DCPIP assay supplemented with kerosene (p-value<0.05). This preliminary study revealed that some bacterial populations survive and thrive in petroleum-contaminated soil and that the kerosene degradation potential of isolates from the reference kerosene sample was higher than the bacterial isolates isolated from soil. Following identification of the isolates by phylogenetic analysis, hydrocarbon-degrading bacterial isolates that exhibited a high hydrocarbon degradation efficacy could be used to bioremediate petroleum-contaminated soil.

Keywords: Bioremediation, hydrocarbon-degrading bacteria, kerosene degradation, redox indicator

E-mail: ayuniweerakoon01@gmail.com

917/D

Impact of COVID-19 lockdown on the prevalence of dengue and bionomics of dengue vectors in Kalutara district, Sri Lanka

C.S.Kariyawasam[1], S.N. Surendran[2], S.K.Wijesekera[3] and H.T.R. Jayasooriya[3]*

[1] *Office of the Regional Director of Health Service, Kalutara*
[2] *Department of Zoology, University of Jaffna, Sri Lanka*
[3] *Department of Zoology, Open University of Sri Lanka*

The unusual reduction in dengue fever cases observed in the Kalutara district during COVID-19 lockdown period was investigated to identify the impacts of public movement restrictions on the bionomics of dengue vectors by collecting data on the prevalence of dengue cases from epidemiology reports and bionomics of *Aedes* vectors from 6 study sites; Panadura, Wadduwa, Bandaragama, Madurawala, Agalawatta, and Walallawita, using WHO recommended methods during the post lockdown period from October 2021 to February 2022. Relevant meteorological data were obtained from the Department of Meteorology. Seasonal Autoregressive Integrated Moving Average (SARIMA) model was used to predict number of dengue cases during lockdown and post-lockdown periods based on number of reported cases for the district. Results obtained were compared with similar findings during the pre-lockdown period and lockdown period. The SARIMA model revealed a significant reduction of dengue prevalence during lockdown period ($p = 0.000$) but the reduction was insignificant during post lockdown period ($p = 0.386$). Pearson's correlation coefficient values show the precipitation had a significant delayed effect of 2 months on dengue prevalence during pre- lockdown period in 4 of the 6 study sites ($p < 0.05$) but the above correlation was not found during lockdown period, indicating rainfall alone has not contributed to disease transmission during the lockdown period. However, COVID-19 lockdown did not have a significant effect on prevalence of dengue vectors based on larval survey, ovitrap survey, and adult mosquito survey data in terms of Breteau Index (BI), Positive Ovitrap Index (POI) and House Density Index (HDI) respectively ($p > 0.05$). The results further show that concentration of *Aedes* breeding sites were higher around public places with *Ae. albopictus* being the dominant *Aedes* species. The potential vector *Ae. albopictus* showed a significant outdoor oviposition behaviour ($p = 0.008$, $F = 12.455$). However, the observed significant increase in *Ae. aegypti* density with endophilic behaviour during pre-lockdown period ($p = 0.027$, $F = 7.364$) became insignificant ($p = 0.094$, $F = 3.605$) in Panadura area during COVID-19 lockdown. The study suggests that closure of public places such as government offices and schools which are the highly infested locations for dengue vectors may have reduced human-vector contact to transmit dengue virus and thereby reducing dengue incidences during COVID-19 lockdown.

Keywords: Covid-19, dengue, Aedes vectors, endophilc behaviour

E-mail: htjay@ou.ac.lk

918/D

Preliminary survey on the gastrointestinal parasites of migratory water birds in Mannar District, Sri Lanka

C. S. Sepalage[1], W. B. Yapa[1], P.N. Dayawanse[1], S. S. Seneviratne[1], A. Nitsche [2] and I. C. Perera[1]*

[1]Department of Zoology and Environment Sciences, University of Colombo, Sri Lanka
[2]Centre for Biological Threats and Special Pathogens: ZBS1, Highly Pathogenic Viruses, Robert Koch Institute, Germany

Migratory birds circulate in different flyways throughout the world and could get infected by sharing common ecosystems. They can be potential disease carriers that can transmit avian diseases to native populations. A cross sectional coprological study was carried to identify most common gastrointestinal parasites in migratory waterbirds. Fresh bird droppings were collected from captured migratory waterbirds using mist nets and noose lines from December 2021 to March 2022 in Talaimannar and Vankalei in Mannar District, Sri Lanka. The samples were analyzed using Shether's sucrose flotation technique. Twenty-eight bird droppings were collected from 28 captured birds. They belong to 12 different bird species sharing common grounds, named: *Charadrius monogolus*, *Charadrius leschenaultii*, *Numenius arquata*, *Thalasseus bengalensis*, *Thalasseus bergii*, *Calidris minuta*, *Dromas ardeola*, *Anas clypeata*, *Tringa totanus*, *Xenus cinereus*, *Calidris ferruginea* and *Nymenius phaeopus*. Among the 28 samples, 24 samples were infected with one or more gastrointestinal parasites. Altogether 10 species of protozoans and helminths were identified. Coccidian oocysts (82.14%) including *Eimeria* (10.71%) and *Isospora* (53.57%), eggs of *Ascaris* (25%), Hookworm (10.71%), *Capillaria* (7.14%), *Strongyloide* (53.57%) and *Maritrema* (3.57%), *Enatmoeba* cysts (17.86%), Strongyle larvae (3.57%) and gut mites (14.29%) were observed in the samples. There was no statistically significant difference between the number of identified helminths (78.57%) and protozoans (71.43%) (Chi square test:χ^2= 0.381: p= 0.5371). Living -in high numbers in flocks, association of common water bodies, travelling thousands of miles around the world could be the reason for the high parasitic prevalence. Birds which travel from the areas with high prevalence in parasitic infections including Southeast Asian region and African region will have a high chance in parasitic disease transmission. The results of the present study suggest that there is a high risk of disease transmission to native birds and to farm animals through associating migratory waterbirds.

919/D

Preliminary screening of orthopoxvirus antibodies in three species of rodents in selected sampling sites in Sri Lanka

S. Siriwardana[1], T. Muzeniek[2], F. Schwartz[2], T. Perera[3], G. Premawansa[4], C. Kohl[2], T.S.P. Fernando[5], I.C. Perera[1]*, S. Premawansa[1], W.B. Yapa[1] and A. Nitsche[2]

[1] Department of Zoology and Environment Sciences, University of Colombo, Sri Lanka,
[2] Centre for Biological Threats and Special Pathogens, Robert Koch Institute, Berlin, Germany
[3]Institute of Biochemistry, Molecular Biology and Biotechnology, University of Colombo, Sri Lanka,
[4] North Colombo Teaching Hospital, Ragama, Sri Lanka,
[5] Department of Zoology, Open University of Sri Lanka

Genus orthopoxvirus (OPV) consist of several important pathogens like variola virus, vaccinia virus, cow poxvirus and monkey pox virus. After eradication of variola virus (smallpox), other orthopox viruses got attention in scientific community with increased cases, most recent example is monkey pox virus outbreak around the globe. Cowpox virus, found rarely in bovines, felines, and exotic zoo animals, and have the reservoir host as rodents. Rodents are an important group to be tested to prevent another viral outbreak that can infect humans through direct contact. In Sri Lanka, there are no records of orthopoxvirus surveillance after smallpox eradication and has a knowledge gap to be filled. Sampling was done in Colombo (6°54'06.5"N,79°51'35.2"E), Kalutara (6°33'56.8"N,79°59'46.1"E), Thaleimannar (9°05'36.6"N,79°42'14.7"E), Poonarin (9°35'19.4"N,80°04'46.7"E), Ambalangoda (6°14'14.0"N,80°03'01.4"E) and Ella (6°50'22.9"N 81°02'56.7"E). Chosen site were close to human settlements. Ten commercial rodent traps were placed in each site with burnt coconut as bait. Captured animals were anesthetized using ether and blood was collected using tail vein bleed method. Standard body measurements were also taken, and animals were released back to the capture site. Blood was allowed to coagulate, and serum was separated using a mobile centrifuge (Biozym, Germany) at 1200 RPM for 10 minutes. Serum and the blood clot were separate and transported at -20 °C and stored at -80°C until analysis. Analysis for anti-orthopox antibodies was done using IFA and ELISA was used as a confirmatory assay. Total of 21 samples tested (*Rattus rattus* (n= 12)*; Rattus norvegicus* (n=6)*; Tatera indica* (n=3)) and from IFA, all samples were negative except for five samples that were giving inconclusive results. ELISA on those inconclusive samples gave one sample positive with 0.02 difference from the cutoff absorbance value. Positive sample was from Indian gerbil (*Tatera indica*) that was captured in Poonarin. This study reports the first record of the presence of orthopox virus antibodies in Indian gerbils in Indian subcontinent and also the first record of OPV in rodents in Sri Lanka. Detailed study is currently underway to identify OPV in peri domestic mammals in Sri Lanka.

Keywords: Orthopox virus, *Tatera indica,* zoonosis, ELISA

E-mail: icperera@sci.cmb.ac.lk

920/D

Mutagenesis of heavy metal binding residues in the heavy metal association domains of CadC protein of *Bacillus megaterium* TWSL_4

W. A. K. Chamindi and C. D. Wijayarathna*

¹Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

Heavy metals are one of the major pollutants of the environment. They are toxic to organisms when they accumulate beyond a certain concentration. Cadmium is a highly toxic heavy metal that accumulates in food chains, water, and soil. Microbial bioremediation uses microbes to detoxify heavy metal contaminants from the environment. Bioremediation has been possible due to the presence of various metal resistance mechanisms in microorganisms. *Bacillus megaterium* TWSL_4 has been found to be resistant to heavy metals such as Cd, Cu, and Pb. Cd resistance is shown due to the expression of the operon *cadCA* which carries two genes, *cadC* that encodes a transcription regulatory protein and *cadA* that encodes a P-type ATPase. *In-silico* studies revealed that there are three heavy metal association (HMA) domains that bind with Cd^{2+} and Zn^{2+} in CadC protein. These domains are, HMA1 [CYS6-CYS10], HMA2 [ASP100-HIS102] and HMA3 [LYS113-ASP116]. The current study was concerned with verification of the discovered (*in-silico*) metal binding domains by site-directed mutagenesis of CadC protein. Amino acids that were selected to substitute the heavy metal binding amino acids in each domain were determined considering the predicted (*in-silico)* secondary structures at the sites of domains, amino acid propensities of Cd^{2+} and Zn^{2+} ions and comparing the physicochemical properties of the substituent amino acids. Codon optimization was performed to determine the most suitable codon of each substituent amino acid to facilitate maximum expression of the mutated protein in *E. coli* BL21 cells subsequently. Mutagenesis of metal binding domains was decided to be carried out through site-specific mutagenesis by overlap extension. Primers for the amplification of two regions with approximately 2.6 kb and 320 bp of *cadCA* operon with the mutations, were designed and amplicons were successfully obtained in PCR. Though overlap extension PCR was performed to obtain the complete *cadCA* operon with the intended (H102Q) mutation in the heavy metal association domain 2, it did not result the specific amplification of the complete *cadCA* operon as expected, hence it is required to be optimized in future.

Keywords: TWSL_4, heavy metals, PCR, amplification

E-mail: dilruksh@chem.cmb.ac.lk

921/E1

Investigation of the latex film formation process by atomic force microscopy

P.K.D.D.P. Pitigala and S.D.A.I. Kumari*

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

Latex film formation is an essential process in the production of latex-based products. Sometimes, a transparent, coherent polymeric film can be obtained by spreading polymer dispersions onto a substrate and then allowing the water to evaporate. This process is known as latex film formation. The structure of the film depends on the type of latex and encircling conditions. Latex film formation process consists of three major stages; drying, particle deformation, and diffusion. The quality of the latex film depends on this process. Therefore, this study evaluates the effect of water content and the quality of the synthetic polyisoprene latex film. Two samples were prepared for this study. Sample 1 was a raw synthetic polyisoprene sample of which the total solid content (TSC) value was 63%. Sample 2 was prepared by diluting sample 1 until TSC value 7.5%. The latex films were prepared by pouring a 2-3 drops of latex dispersion (sample 1 and sample 2) onto a mica sheet and allowing the film to dry slowly at 35 °C for 2 h. All latex samples were imaged by atomic force microscopy (AFM). When comparing latex films, which produce low water content (TSC = 63%) latex dispersion and high water content (TSC = 7.5%) latex dispersion, the synthetic polyisoprene film formed with less water content has fewer cracks/voids than the film formed with high water content. Cracks and voids can be formed as a result of pressure drops occurring as water flows through the packed-particle area of the film. The final conclusion of this study is that in synthetic polyisoprene latex, minimum cracks/voids can be formed by using a high TSC value containing latex dispersion. It means high quality (having fewer cracks and voids) synthetic polyisoprene films can be obtained by using less water content in latex dispersion.

922/E1

Impact of COVID-19 lockdown and Influence of local wind profile on air quality in Colombo

Piushani Ellegala* and L.D. Jayasuriya

Central Environmental Authority, Kalutara

During the period from 19th March to 10th May 2020, Sri Lanka showed a drastic change in transport, industrial and domestic activities due to the national lockdown associated with the Covid-19 pandemic. A comparison between during and pre lockdown periods with respect to air pollution and local wind profile are studied here. The study site at Battaramulla is a representative location of the city with different characteristics including major routes, land use and population density. Hourly pollution and wind measurements were obtained with an EPA accredited high performance air quality monitoring station. Exploratory data analysis includes lag and composite analysis and data visualizing of the pollutants were obtained using "open-air" package in R software. The diurnal, weekday and monthly pollution variations are remarkably low during the lockdown period. Diurnal variations during pre-lockdown show that all the pollutants tend to peak around 8.00–9.00 am, which is more related to local traffic time and weekday variations show that the concentrations are much lower at weekends. Although the pollution variation during the lockdown period is much low, it follows the variation at pre-lockdown since the activities related to health and essential services were not suspended. Bivariate polar plots depict the combined effect of wind speed and wind direction on pollutant concentrations and possible geographic origins of the pollutants. The polar plots show that the PM2.5, PM10 and CO are distributed over the direction of high traffic volume with relatively low wind speeds. The highest concentrations of SO_2 and NO_2 are linked with South-East and West directions and depicts the presence of multiple sources of SO_2 and NO_2 during the pre-lockdown period. O_3 shows an opposite pattern to that of NO_2 and SO_2. Overall, time variations and polar distributions show the elevated pollution levels during the pre-lockdown period where the local traffic volumes are strongly connected. Even though the lockdown period is much shorter, there could have short-term respiratory health benefits due to lower air pollution. Hence, these outcomes can be utilized to inform policy makers to reduce source emissions from vehicles and industries to improve public health.

Keywords: Covid-19, air quality, pollutants, traffic volume

E-mail: piushanivimu@gmail.com

923/E2

Construct design for CRISPR/Cas9-mediated K/O of the allosteric activator binding domain of PFK-1 in MCF-7 cells and the assessment of its transfection efficiency for the development of a novel therapeutic approach for cancer

W.M.S. Hansika and G.N. Silva[*]

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

Cancer is a leading cause of worldwide deaths, which requires novel and effective strategies to block cancer growth and metastasis. Modern cancer treatments mainly focus on the metabolic targeting of cancer cells as they have altered energy metabolism to achieve high proliferative rates. Cancer cells exhibit "aerobic glycolysis" where they convert glucose into lactate even in the presence of high oxygen levels and fully functioning mitochondria; the phenomenon known as Warburg effect. As a result of increased activity of critical glycolytic enzymes, cancer cells show increased rates of aerobic glycolysis and therefore, targeting key glycolytic enzymes to down-regulate the rate of glycolysis would be an effective approach to suppress cancer progression. This research focuses on CRISPR/Cas9-mediated K/O of the allosteric activator (Fructose-2,6-bisphosphate) binding domain of phosphofructokinase-1 (PFK-1), which catalyzes the rate-limiting step of glycolysis to down-regulate the activity of PFK-1 and proliferation of cancer cells. The CRISPR vector construct was engineered by cloning a specific crRNA that targets the inter-domain region of PFK-1. Next, a suitable donor template with minimal off-targets was designed to facilitate the production of truncated PFK-1 that lacks the allosteric domain. After transfection optimization, polyethyleneimine (PEI)-mediated transfection was performed to introduce the donor template together with the vector into MCF-7 breast cancer cells followed by puromycin selection to identify successfully transfected cells. The optimal ratios of PEI (µg) to DNA (µg) for transfection was determined to be 3:1, 4:1 and 6:1, which resulted low cytotoxicity. The successfully transfected cells should be subjected to clonal expansion and downstream assays to confirm the genetic modification, followed by cell proliferation assays to investigate the effect of modified gene function. Down-regulation of PFK-1 activity may be a safer therapeutic approach to treat cancer over complete K/O of PFK-1 as the truncated PFK-1 may still exhibit sufficient catalytic activity for the function of healthy cells yet may have a significant impact on energy-centric metabolism in cancer cells.

Keywords: CRISPR/Cas9, PFK-1, cancer, specific crRNA, CRISPR construct

E-mail: gayathris@chem.cmb.ac.lk

924/E2

Development of a fluoride riboswitch-based biosensor to detect fluoride concentration in drinking water

L.N.A.J.P. Nissanka, E.K.D. Abeyrathne, M. Satharasinghe, P. Banushan and G.N. Silva*

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

The quantitative determination of fluoride levels in drinking water using an accurate and selective method is crucial due to the prevalence of health issues such as dental and skeletal fluorosis. However, sensitivity, reliance on expensive analytical equipment, interference by other ions and utilization of toxic organic solvents are some of the major issues associated with the currently applied fluoride detection techniques. In this study, we have exploited the fluoride riboswitch (FRS), a fluoride-specific RNA *cis*-acting gene regulatory element as a tool to detect intracellular fluoride levels. FRS can be advanced as a biosensor to detect fluoride in an aqueous solution, as riboswitches are found to be highly specific for their ligand. Here, an *E.coli* mutant harboring a recombinant plasmid containing the fluoride riboswitch fused to the *lacZ* reporter gene is utilized as a whole-cell biosensor to monitor fluoride. The binding of fluoride into the aptamer region of fluoride riboswitch increases the expression of β-galactosidase, which then hydrolyzes the *ortho*-nitrophenyl-β-galactoside (ONPG) into yellow color product, *ortho*-nitrophenol (ONP), which is detected at 420 nm. In the calibration curve, a significant linear correlation between ONP and fluoride concentration was observed up to 100 μmol/dm^3 ($R^2 = 0.9905$). According to the results, water samples from Kurunegala (5.7×10^{-5} mol/dm^3), and Mullaithivu (4.7×10^{-5} mol/dm^3) have the highest fluoride level compared to other regions of the country. Furthermore, the presence of common interfering ions (OH^- and Cl^-) showed a significant interference on the biosensor activity possibly due to their effect on bacterial growth and/or reporter enzyme activity. Limitations associated with the whole-cell biosensor can be reduced by the construction of a cell-free FRS biosensor which can be used as a portable, cost-effective fluoride detection method for the on-site determination of fluoride in natural water bodies.

Keywords: Biosensor, fluoride detection, fluoride-riboswitch, ONPG

E-mail: gayathris@chem.cmb.ac.lk

925/E2

Value addition to cassava bagasse: Development of cassava bagasse incorporated vanilla flavored cookie with high consumer acceptance

M.K.H. Lakmini and M.A.D. Somendrika*

Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Cassava bagasse is the waste generated in the cassava starch processing industry. Bagasse was produced in amounts ranging from 54% to 60% during cassava starch processing and on a dry weight basis, it consists of roughly 30–50% starch content too. Hence, in this study, the dried powder of bagasse was used to develop cookies. A two-factor factorial design was selected as the experimental design. Results of this study showed that cookies incorporated with 40% cassava bagasse powder which was steamed for 5 mintues, was the best among other samples as it had recorded the highest sum of ranks for color, appearance, aroma, taste, after taste, texture and overall acceptability. Analysis of developed cookies revealed moisture content of 2.31 ± 0.02 %, fat content of 23.54 ± 0.04%, crude protein content of 4.55 ± 0.04%, reducing sugar content of 18.31 ± 0.08%, total ash content of 0.80 ± 0.11, crude fiber content of 5.89 ± 0.02 and carbohydrate content of 46.65 ± 0.04%. Furthermore, mineral composition of cookie was recorded as 98.40 mg/kg, 22.46 mg/kg, 40.49 mg/kg, 260.62 mg/kg and 2706.46 mg/kg for iron, calcium, zinc, magnesium, and potassium, respectively. Developed cookies recorded a higher saturated fat percentage but a much lower amount of trans fats. The monounsaturated fat content of cookies was higher than the polyunsaturated fat content. Furthermore, textural results of developed cookies gave values of hardness 12755 ± 2934 (g), cohesiveness 0.2250 ± 0.02, springiness 46.38% ± 7.25, gumminess 4335 ± 875 and chewiness 2003 ± 706. As well as recorded L*, a* and b* values were respectively 67.13 ± 1.3, 9.56 ± 0.51 and 25.2 ± 1.27. The processed products of cassava samples contained relatively lower cyanide values compared to the fresh flesh of the roots. This cookie contained 1.97 mg/kg cyanide content. According to shelf-life analysis, the product is safe to consume for more than one month. In conclusion, cassava bagasse could be incorporated into bakery products like cookies by around 40% after 5 minutes of steaming. In addition, this developed cookie supplies lots of nutritional properties for consumers. Therefore, this by-product can be utilized for human consumption.

Keywords: Cassava bagasse, cookies, waste utilization

E-mail: dsomendrika@sci.sjp.ac.lk

926/E2

Determination of heavy metals and sodium laureth sulphate content in selected herbal hair shampoo commercially available in Sri Lanka

P.V.M.M. Perera and B.A. Perera*

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

The study was undertaken to determine the heavy metal content and the sodium laureth sulphate (SLES) content in five herbal shampoo products available in local markets of Sri Lanka. Six heavy metals; namely, Cd, Cr, Cu, Pb, Ni and Zn were quantitatively assessed in these shampoo brands using atomic absorption spectrophotometry (AAS). For Cd, Cr, Cu, Pb and Zn determination, the graphite furnace atomic absorption spectrophotometry (GFAAS) was employed, whereas Ni was determined using flame atomic absorption spectrophotometry (FAAS). Out of these heavy metals, Pb (1.45–4.11 µg/g), Cd (0.11–0.29 µg/g) and Ni (2.67–4.08 µg/g) have shown concentrations below the maximum permissible levels given by standards provided by authorities, while Zn (9.16–34.74 µg/g), Cu (2.99–10.32 µg/g) and Cr (1.10–2.50 µg/g) have shown exceeding levels than the maximum permissible limit by some or all of the brands. The SLES levels of the shampoo brands were evaluated by a titrimetric method using cetyltrimethylammonium bromide and sodium oleyl sulphate. All the herbal shampoo brands have shown higher SLES levels (9.0-13.0 per cent by mass) in comparison to the maximum permissible levels. Furthermore, the heavy metal content of herbal shampoo brands has been compared with two synthetic hair shampoo brands. It is challenging to state whether the values obtained for some of the heavy metals concentrations in this study are too high or too low because there are only a few safe-limit regulations with respect to the cosmetic products in Sri Lanka. It also stresses the fact that consumers cannot disregard the products' doubtful nature since a major part of developing or underdeveloped nations struggle to produce quality personal care items. This study has shown alarming levels of sodium laureth sulphate and heavy metals in the majority of branded herbal shampoo products, which may be harmful to individuals and communities, especially those who are with sensitive skin and hair conditions. Long-term usage of these products may result in skin irritation and eye irritation, heavy metal toxicity, and other adverse effects despite the nutritional impacts they may claim.

Keywords: Shampoo, heavy metals, AAS, sodium laureth sulphate

E-mail: basirip@sjp.ac.lk

927/E2

Enhanced removal of heavy metals in wastewater using amino mesoporous silica nanoparticles

A. Pathiraja[1], S.H. Kumarage[1] and I. Munaweera[1,2]*

[1]Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Instrument Center, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Aqueous waste contaminated with toxic heavy metal ions, which are persistent and non-biodegradable, cause major health effects due to accumulation in living organism *via* food chains. Thereby, attention is paid by researchers for decades regarding this matter and adsorbing heavy metal ions on to a surface is one of the best options for scavenging heavy metals. In this research, we studied Cu(II) removal from aqueous effluents using di and tri amino functionalized mesoporous silica nanoparticles (AMS). Here, di and tri-AMS were synthesized *via* timesaving, efficient, microwave-assisted sol-gel method in basic medium. For confirmation of amino modification, Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, dynamic light scattering (DLS) and scanning electron microscopy (SEM) characterization methods were used. In FTIR spectra of both AMS, peaks around 1030 cm^{-1} confirmed Si-O-Si asymmetric stretching, while peaks located around 1450 cm^{-1}, which corresponds to N-H bending vibration, demonstrated that amino modification has successfully taken place. Furthermore, SEM and DLS results illustrated that synthesized particles were in nano range around 250 nm with porous texture. In adsorption experiments, only one trial was conducted at pH 5.3. A 10 mg amount of di-AMS with 60% of amino percentage exhibited approximately 16%, 23%, 23%, 26% and 28% maximum removal percentages after 48 hours for 5, 20, 50, 80, 110 ppm of initial Cu(II) concentrations, respectively. Whereas, for the same experiment with same initial concentrations, tri-AMS exhibited removal percentage values of 29%, 35%, 37%, 37% and 36%. Results concluded that tri-AMS has more effectively contributed to heavy metal removal than di-AMS due to high density of amino groups on the surface. With respect to correlation factor, adsorption of Cu(II) ions on to di and tri-AMS was fitted better by Freundlich model than Langmuir model, concluding multilayer adsorption occurred on AMS. According to obtained data, the most suitable kinetic model was reported as pseudo-first-order model illustrating that the adsorption rate is proportional to the number of free sites. Overall, the potential of using a cost effective, eco-friendly adsorption material; di and tri-AMS for Cu(II) removal from aqueous solutions, is emphasized in this research, which will lead to novel purification methods in further advancements.

Keywords: Heavy metal, wastewater, mesoporous, silica nanoparticles, copper(II)

E-mail: imalka@sjp.ac.lk

928/E2

Fabrication and characterization of N, P, K nutrient-loaded electrospun cellulose acetate nanofiber mats to be used as a slow-release fertilizer

W.A.M.B Fernando[1] and I. Munaweera[1,2]*

[1]Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Instrument Center, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The potential use of electrospun nanofibers in agricultural applications has been elaborated in the literature. However, the development of nanofibers for such applications is still in its infancy. In this study, we report the novel fabrication of a cellulose acetate (CA) nanofiber mat loaded with three different types of nutrients fabricated *via* the electrospinning technique. The nutrients loaded were urea, hydroxyapatite nanoparticles (HANPs) and muriate of potash (MOP) as sources of the major macronutrients, nitrogen, phosphorus and potassium, respectively. Each of the nutrients was loaded at 10% based on the weight of the CA polymer. The HANPs incorporated into the mat were synthesized by the wet chemical precipitation method. The solvent system of dimethylformamide (DMF) to acetone in the ratio of 1:2 v/v was employed in the fabrication of the nanofiber mats. Furthermore, the electrospinning parameters were studied carefully to obtain a reproducible fabrication method for this nanofiber mat. The morphology of both the synthesized HANPs and the electrospun nanofiber mat was studied using scanning electron microscopy (SEM). The nanofibers of the nutrient-loaded mat exhibited a reduced average diameter with respect to those of the neat nanofiber mat. The successful loading of each of the nutrients was confirmed by the shifts and changes in peak positions for functional groups of the nutrients *via* Raman spectroscopy. The successful synthesis of the nanoparticles was also confirmed *via* Raman spectroscopy. A preliminary release study to determine the slow-release behaviour of the loaded nutrients was also conducted. Our results suggested that the fabrication of urea+ HANPs+ MOP loaded-electrospun nanofiber mat is feasible and with greater increase in the loading percentages, it could be harnessed as a potential slow-release fertilizer with enhanced slow-release behavior.

Keywords: Electrospinning, hydroxyapatite, cellulose acetate, fertilizer, slow-release

E-mail: imalka@sjp.ac.lk

929/E2

Comparative study on the Rhodamine B removal ability of CuO and CaO nanoparticles synthesized using plant extracts

A.A.B.S. Wijeratne and S.M. Vithanarachchi*

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

Industrial textile effluent comprises of a complex mixture of chemical compounds, the most noticeable of which are the traces of leached synthetic textile dyes visibly observed due to the vibrant colours they impart to the wastewater. High resistance to biodegradation conferred by their chemical structures causes these dyes to persist in the effluent requiring external mediation for complete removal from the effluent. In recent years, nanoparticles (NPs) have been garnering interest as potential candidates for the removal of synthetic textile dyes. The ability of bolstering the properties of fabricated nanoparticles through plant-mediated synthesis to form highly efficient, sustainable, effluent-remediating agents have pressed further research along this scope, setting the stage for the current study. Copper oxide (CuO) and calcium oxide (CaO) NPs were synthesized by mixing the respective metal salts with pomegranate peel extract utilizing co-precipitation method. The produced NPs were characterized by UV-visible spectroscopy, Fourier transform infrared spectroscopy, and scanning electron microscopy. The dye-removal ability of the produced particles was then determined on the dye, Rhodamine B. Evaluation of the dye-removal ability of the NPs was performed after optimization of nanoparticle amount (50 mg/mL), pH (6), and time of exposure to sunlight (60 min). Chemically synthesized NPs, *i.e.,* nanoparticles synthesized without plant extracts, and untreated dye solutions were used as controls. Plant-mediated CuO NPs exhibited a good efficiency in removal of Rhodamine B (removal efficiency under sunlight irradiation-85%, in dark-43%) while chemically synthesized CuO NPs were not that efficient (under sunlight-13%, in dark-5%). However, both plant-mediated CaO NPs (under sunlight-45%, in dark-15%), and chemically synthesized CaO NPs (under sunlight-34%, in dark-7%) were not that efficient in removal of Rhodamine B compared to CuO NPs. It is known that CuO NPs are semiconductors, thus under sunlight, photocatalytic degradation is facilitated enhancing the dye-removal ability of CuO NPs. Based on the results, the plant-mediated NPs are more efficient at removing Rhodamine B than the chemical counterparts. Natural compounds in plant extracts are expected to be incorporated into NPs during the synthesis. These natural compounds are likely to play a role in the photocatalytic degradation process by increased production of radicals. This study reveals the performance of different metal oxide NPs towards the removal of dye and an avenue to improve the use of metal oxide NPs for the same by simply combining them with plant extracts.

Keywords: Copper oxide, calcium oxide, rhodamine B, pomegranate peel extract

E-mail: sashimv@chem.cmb.ac.lk

930/E2

Development of ZnO and Fe₃O₄ nanoparticles incorporated antibacterial polymer film for dermal applications

W.T.D.D. Fernando, K.M.N. de Silva and W.R.M. de Silva*

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

Dermal patches can be used as a treatment for external skin infections and skin microbiome 'dysbiosis' conditions, which means the imbalance in the changes of skin microbiota causing disease conditions predominantly acne and pimples. This research reports the development of novel dermal patches with anti-bacterial, antioxidant, and anti-inflammatory properties by incorporating ZnO and Fe_3O_4 nanoparticles. ZnO nanoparticles were synthesized by chemical synthesis using zinc acetate and sodium hydroxide. Synthesized ZnO nanoparticles were incorporated into carboxymethyl cellulose (CMC) biopolymer film by cross-linking with citric acid and glycerol. ZnO-CMC hydrogel polymer was used for the *in-situ* mineralization of Fe^{2+}/Fe^{3+} ions, followed by NH_4OH to synthesize Fe_3O_4 nanoparticles inside the biopolymer matrix by the coprecipitation method. The ZnO-CMC-Fe_3O_4 nanocomposite film was characterized by Fourier transform infra-red (FTIR) spectroscopy and X-ray diffraction (XRD). Increased thermal stability after the incorporation of ZnO and Fe_3O_4 nanoparticles was examined using thermogravimetric analysis (TGA). The surface morphology of the metal oxide nanocomposite film with two different nanoparticles was observed through scanning electron microscopy (SEM). The antibacterial properties were inspected with Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli* bacterial species. The bacterial species were aseptically inoculated in Tryptic Soy Broth (TSB) and a 1/10th dilution of the cell culture medium was used for the analysis. A 50 mL of diluted culture medium was shaker incubated with ZnO-CMC-Fe_3O_4 nanocomposite film as the sample and another 50 mL of diluted culture medium was shaker incubated with the same sized neat CMC biopolymer hydrogel as the control for the antibacterial assay. At 2-hour time intervals, the cell culture media were examined using the total viable cell count method (CFU/mL). Greater antibacterial activity against gram-positive *S. aureus* than gram-negative *E. coli* was observed. According to the results, the novel ZnO-CMC-Fe_3O_4 antibacterial nanocomposite biopolymer film can be developed as a dermal patch for skin-related pathogenic, and inflammatory problems.

Keywords: Zink oxide, iron oxide, nanoparticles, dermal patches, biopolymer

E-mail: rohini@chem.cmb.ac.lk

931/E2

Stability of *Cinnamomum zeylanicum* "Sri Vijaya" aqueous extract and chemical analysis of its residue

B.M. Jayawardena* and B.S. Wanniarachchi

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

Diabetes is the most common non-communicable disease in the world. As the *Cinnamomum zeylanicum* "Sri Vijaya" (CCSV) accession has shown antidiabetic activity, its aqueous extract can be used as a liquid form antidiabetic nutraceutical. The objective of the present study was to measure the α-amylase stability of a CCSV aqueous extract as well as to determine the antidiabetic activity and the composition of the essential oil extracted from the residue that remained after the aqueous extraction. In this study, the antidiabetic compounds in powdered CCSV quills were extracted by pressurized water extraction method (15 psi, 100 mL for 15 minutes). The extract was transferred into sterile test tubes sealed with cotton swabs and aluminum foil and stored in the refrigerator at 4 ℃. Antidiabetic effect of the extract was tested by the α-amylase inhibition assay at 0 time and then every week up to 5 weeks. The residue that remained after the extraction was distilled using the Clevenger apparatus and the essential oil collected was analyzed using α-amylase inhibition assay and HPLC. According to the results, the IC_{50} value of the fresh extract was 94.50 (±1.38) μg/mL and it gradually increased to a value of 136.03 (±1.60) μg/mL by the fifth week, showing that its antidiabetic activity reduces with time. However, when comparing these values to previously conducted research, this reduction is much less than the reduction in antidiabetic activity of the extract obtained at 0.098 MPa (413 μg/mL for fresh extract and 2410 μg/mL for extract obtained on 7th day) which has shown a much higher reduction on a daily basis. It was also noted that there was no sample contamination during this period due to aseptic conditions. The IC_{50} value obtained for the essential oil was 482.00 (±1.06) μg/mL. This means the residue still has more antidiabetic compounds remaining in it. This was further confirmed by the HPLC chromatogram, which proved that there is considerable amount of (*E*)-cinnamaldehyde and *trans*-cinnamic acid remaining in the residue. In conclusion, the CCSV extract obtained at 15 psi can be stored for a longer period and the residue after aqueous extraction still shows some antidiabetic activity.

Keywords: Aqueous extract, *Cinnamomum zeylanicum*, Diabetes, Nutraceutical, Stability

E-mail: dakshikacw@kln.ac.lk

932/E2

Photodegradation study of crocetin, an apo-carotenoid extracted from the stigma of saffron flower (*Crocus sativus* L.)

R.M.T.N. Perera and D.D.D.H. Alwis*

Department of Chemistry, Faculty of Natural Sciences, The Open University of Sri Lanka, Nawala, Sri Lanka

Carotenoids are naturally occurring pigments, consist of eight terpene units with a skeleton of forty carbons and conjugated double bonds. This conjugated system can act as a chromophore to absorb light and give characteristic three peak spectra in which peaks appear in the visible region of the electromagnetic spectrum. Apo-carotenoids are derivatives of carotenoids, and similar to carotenoids, apo-carotenoids also can absorb a broad range of solar radiation and this feature of apo-carotenoids has made them important in dye sensitized solar cells. Prolonged exposure of carotenoids to visible light, air, heat, leads to isomerization and oxidation causing degradation of carotenoids. Complete loss or change in color indicates the degradation of carotenoids. Carotenoids can also photo-catalytically degrade in the presence of catalysts. TiO_2 nanoparticles act as a photocatalyst due to their efficient photoactivity and high stability. In the present study, an apo-carotenoid consisting of terminal carboxylic acid groups, crocetin, which is extracted from the stigma of the saffron flower was selected to study the photocatalytic degradation of carotenoids in the presence of O_2 and N_2. This investigation was carried out to find the possibility of using them in dye-sensitization of photovoltaic devices. The effect of crocetin degradation was analyzed by measuring the absorbance at 425 nm at 20 minutes time intervals. The degradation of crocetin in the presence of TiO_2 coated and non-coated glass plates were investigated by irradiating crocetin solution with a visible light source. The effect of photocatalytic degradation of crocetin in the presence of N_2 and in the presence of O_2 was also investigated separately by purging N_2 and O_2 to the solutions while irradiating with the visible light. The results of this study revealed that the gradual decrease of crocetin absorbance at 425 nm is lower in the absence of TiO_2 nanoparticles than in the presence of TiO_2 nanoparticles. Furthermore, the results obtained by absorbance decay curves of crocetin in the presence of O_2 is higher than in the presence of N_2. The formation of radical cations of crocetin due to photo-induced decomposition was also observed prominently in the presence of O_2 than in the presence of N_2.

Keywords: Carotenoid, photodegradation, Photo-catalyst, apo-carotenoids, Radical cations

E-mail: ddalw@ou.ac.lk

Sponsors for Annual Sessions 2022

National Science Foundation

World Health Organization Country Office Sri Lanka

Commercial Bank

Ceylon Biscuits Limited

Sri Lanka Tea Board

Orange Electric Company

Mr Punsiri Tennakoon

Well-wishers