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(*i*PURSE - 2016)

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MESSAGE FROM THE VICE-CHANCELLOR

UNIVERSITY OF PERADENIYA

Peradeniya University International Research Sessions (iPURSE- 2016)

It is indeed a privilege and pleasure to issue this message of felicitation on the occasion of the third International Peradeniya University Research Sessions 2016 (*i*PURSE 2016) scheduled to be held on 4th and 5th November 2016. I consider this as one of the most important events in the University Calendar, next to the General Convocation. Every year, a different Faculty takes the responsibility of organizing the *i*PURSE. This year, the Faculty of Dental Sciences has come forward to organize this magnificent event on a grand scale. The theme of the *i*PURSE 2016 is "Towards Building a Sustainable Future".

It is my sincere wish and hope that the forthcoming *i*PURSE will serve as a forum for academics/researchers/scientists to gather new information, disseminate new knowledge, exchange views and ideas and share their research findings and experiences while creating an opportunity to develop national and international collaborations.

Research is an integral part of academic life. Hence, it is not only a duty but also our responsibility to identify and introduce scientific solutions for pending issues in the society through research. However, there are no direct answers for complicated unresolved multifaceted issues that mankind faces today. Therefore, "multidisciplinary research with a collaborative approach" has become the order of the day.

I also wish to congratulate the Chairperson Dr. A.K.S. Arambawatta and the members of the Organizing Committee for planning this significant event, keeping in line with the standards and traditions of the University of Peradeniya. Furthermore, while congratulating all the presenters for their utmost commitment to research, I hope that the outcomes of their research findings will contribute to the development of the society locally as well as globally. In conclusion, may I wish all of you all the very best, and hope you will carry home fond memories of this great event.

Professor Upul B. Dissanayake
Vice-Chancellor
University of Peradeniya

MESSAGE FROM THE CHAIRMAN
ORGANIZING COMMITTEE

*Peradeniya University International Research Sessions (i*PURSE- *2016)*

On behalf of the Organizing Committee welcome you to the Peradeniya University International Research Sessions (*i*PURSE) 2016.

As in previous years, *i*PURSE provides an excellent forum to bring researchers from different disciplines to a common platform to disseminate their findings, exchange knowledge and build partnerships on a wide variety of topics

The theme of the 20th Annual Research Sessions, *i*PURSE – 2016 is "Towards Building a Sustainable Future and the program includes a range of inspiring keynote addresses from eminent scientists and scholars. The 20th Annual Research Sessions of, *i*PURSE – 2016, has accepted a total of 447 submissions following peer review of which 329 will be oral presentations and 118 poster presentations. These will be presented in parallel sessions under ten board themes covering Climate, Environment and Earth Sciences, Economics and Management, Education, Engineering and Built Environment, Food Nutrition and Livestock, Health Sciences, Information Technology, Mathematics and Statistics; Natural Sciences; Plant Sciences and Forestry, and Social Sciences and Humanities. .

The Faculty of Dental Sciences considers it a privilege to have been given the opportunity to host *i*PURSE 2016. However, *i*PURSE 2016 is a joint effort of all faculties as well as different branches of the university administration. On behalf of the Organizing Committee I wish to express my profound gratitude to the Vice-Chancellor, Professor Upul B. Dissanayake, and the Dean of the Faculty of Dental Sciences, Professor W.M. Tilakaratne for their support. Let me also take this opportunity to thank the contributors, the editorial board, members of the organizing committee including the chairpersons and members of the sub-committees as well as everyone who helped in numerous ways to make *i*PURSE 2016 a success.

While warmly welcoming all delegates to *i*PURSE 2016, I hope that participation at iPURSE 2016 will be a rewarding experience to them.

DR. A.K.S. Arambawatta
Chairperson, *i*PURSE Organizing Committee-2016

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Ms MHARJ Perera

Back to basics: sustaining wisdom and morality

L. Samaranayake

Honorary Professor and Immediate Past Dean of Dentistry, University of Queensland, Australia, and Professor Emeritus, and Immediate Past Dean of Dentistry, University of Hong Kong, China

The Sanskrit adage *Sarvasva Locanam Sastram*or `*Knowledge is the eye unto all*` is the motto of the University of Peradeniya. From 1942, since its establishment as the first university of Sri Lanka, this institution has been the font of knowledge and wisdom for essentially tens of thousands of Sri Lankans for more than seven decades. The world has rapidly moved on during this period and we are witnessing an age of technological wizardry never before imagined by our forefathers. Hand in hand with the technology we see great strides in research advances and it is imperative that we sustain our basic values of veracity, integrity, resourcefulness and adaptability particularly in the face of economic and livelihood stresses that are all too common today. In order to sustain our wisdom and morality now is the time to return to these basics. Humility, enthusiasm, hard work, courage, collaboration, friendship and drive are all too easily forgotten in these tumultuous times. All of the above applies to research, which has been stated as 'play carried into adult life'. Particularly the young investigators who are distracted by the world out there need to return to the basics in order to build a firm foundation and not a facile façade. These and other societal issues facing researchers today will be the highlight of this presentation.

Capturing a new opportunity: knowledge management

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Knowledge Management (KM) is the process of capturing, distributing, and effectively using knowledge. Leading organizations, both in the public and private sectors are trying to utilize this new opportunity and exploit to advantage. KM has become easy with the modern advances in the field of Information and communications technology. Today, KM is a multibillion-dollar business. KM provides a new opportunity for Sri Lanka to leap-frog into economic prosperity. However, there are some basic constraints that the country needs to overcome prior to entering the KM world. Universities are considered to be the generators and repositories of new knowledge. Hence, Universities should play a significant role in facilitating this new business for Sri Lanka.

Towards a sustainable future: managerial reflections

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Sustainability is a serious issue in front of any human being living today, and it is about adopting business strategies and activities that meet the needs of the organization and its stakeholders while preserving, conserving, protecting, and improving the natural environment, and human and other resources. In fact, environmental and social issues and economic issues are not competing interests, and they can and must be optimized simultaneously for both short-and-long-term success. Sustainability is indispensable owing to avoidance of numerous detrimental effects of commerce and the dangers of narrowly pursuing maximization of profits. The Triple Bottom Line (TBL) is the most popular among several sustainability-related paradigms. A careful examination of the barriers to sustainability and sustainability issues and practices reveals that Human Resource Management (HRM) plays and will have to play a critical role in making an organization sustainable. It is critical for embedding sustainability across the organization. Integration of sustainability into HRM results in three dimensions such as Green HRM, Social HRM and Strategic HRM, of which Green HRM is the most important as the Planet is the most important out of the three Ps. Activating on sustainability is a responsibility of every human being and it needs to be a reality rather than a rhetoric.

A bottom up approach to design stable robots for unstructured environments

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The emerging area of soft robotics and morphological computation views the body not only as a mere anatomical structure, but also as an important resource that contributes to the computation of perception and action. This phenomenon is not only limited to single organisms, but also seen in human interaction with robots and intelligent built environments. In this talk, I will show some results of the recent work in my "laboratory for morphological computation and learning" to suggest the benefit of viewing the whole body as a unified computational machine to highlight the benefits of using new design guidelines we propose. Efficient and stable robots built this way will make radical changes in many areas like remote medical intervention, agriculture, underwater construction, and manufacturing with humans and robots working in shared workspaces. I will discuss some recent results in soft robots tested in the areas of minimally invasive surgery, haptic based indoor guiding in low visibility environments like fire-fighting, remote examination of soft tissue in remote medical examination, sensor-less stabilization of biologically inspired robotic hoofs for agriculture support in mountainous areas, and optimum hardware evolution for knee-implants. I will also make an attempt to outline possible areas for collaboration with researchers based in Sri Lanka, who will be interested in the general area of emergence of behavior in dynamic systems.

Linking agriculture, nutrition, and health: role of dietary transition

S.T.C. Mahawithanage

Consultant Nutritionist

The best approach to find positive synergies among agriculture, nutrition, and health largely depends on a country's position in the dietary transition; from a diet low in both calories and micronutrients (Stage One) to a diet that provides adequate basic energy for most people but inadequate in nutrient balance (Stage Two) and then to an affluent diet that begins to provide excessive calorie energy, which can lead to health problems linked to obesity (Stage Three).

Sri Lanka's status of dietary transition is complex in nature and significantly influenced by the recent rapid economic transition. Current burden of non-communicable diseases is a direct outcome of such transition. Diets centred on cheap, calorie-dense, nutrient-poor foods including both "fast foods" and nutrient-poor staples are deepening the problem in the country.

Over the past years, agricultural development in Sri Lanka has focused on a paradigm of increasing productivity in terms of enhancing food availability and maximizing production of cereals or a system that is able to address mainly the energy requirements.

Thus the necessity of a shift in the conceptual framework for developing strategies for action, placing nutrition related prime concerns is obvious. It is high time for all of us to revisit the current framework for better strategies so that agriculture can make an even greater contribution to health and nutrition.

Health research – where do we start?

V.Thevanesam

Professor Emeritus, University of Peradeniya, Sri Lanka

Academia is described by Wikipedia as 'the environment or community concerned with the pursuit of research, education, and scholarship'. Although many academics are actively engaged in research, there are several, particularly at an early stage of their academic career who are uncertain of how to commence their research activities.

What then is research? Guidelines for Collecting and Reporting Data on Research and Experimental Development in The Frascati Manual (2015) produced through OECD (The Organization for Economic Co-operation and Development) defines research as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humans, culture and society and the use of this stock of knowledge to devise new applications". This creative activity can and does vary widely between different fields of study. Scientific research searches for accurate data requiring careful analysis to answer questions and formulate theories on the nature and properties of the world we live in whereas research in the humanities often does not answer question but seeks to explore issues.

In this context, how do we understand 'health research'? The WHO in 1948 described health as "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". However, in recent times, this definition and particularly the use of the term 'complete' have been challenged. Machteld Huber and colleagues (BMJ 2011;343:d4163) suggest that the WHO's emphasis on complete well-being does not meet the health needs of the present time where a steep rise in chronic disease needs the individual and community to adapt and self-manage in the face of social, physical and emotional challenges. Health research results from interaction of many disciplines studying a 'health' need and should be responsive to community and national priorities. It could also commence through the interest or curiosity of individuals. Such research could be biomedical/experimental research, clinical in the many aspects of clinical care, translational/applied where research output is used in practical ways and dealing with the very many social, including economic issues affecting human health and well-being.

Individual disciplines possess their own opportunities and challenges to commence and maintain a research lifestyle. Using infectious diseases in Sri Lanka as my area of research, I will share some ways in which ideas for research were generated and outcomes of such research activity. From the simple to the complex, there are many unanswered questions in the broad arena of 'health' and young academics need every encouragement to commence and pursue a life of research which will satisfy their own aims and aspirations and make substantial contributions to improvements in health and equity for the Sri Lankan population.

Agriculture mobile application for farmers

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Timely and relevant agriculture information is essential for farmers to make effective decisions. Finding the right approach to provide this information to empower farmers is vital due to the high failure rate in current agricultural information systems. As most farmers now have mobile phones we developed a mobile based information system. We used the participatory action research methodology to enable high farmer participation to ensure sustainability of the solution. Current version of the application based on preliminary studies focused on the crop choosing stage, crop growing stage and crop prices and managing expenses of the farming life cycle. Currently the system uses a database and a knowledge base to manage the information and there are over 100 crops and a variety of information that have been populated for various vegetables. Farmers can also view their past farming activities during the process to make effective decisions.

Future research would link this application with some private sector companies in order to reach a wider farming community covering crops such as maize, gherkins and cinnamon. It would take some time to do the required analyses and identify the requirements before we can implement a suitable system with company own dash boards etc. Also as future work, we are looking at how to provide weather data, micro finance information etc. to the farmers.

Innovation includes the ability to obtain crop details, fertilizer details and compute the required investment to grow a selected crop. It will have a potential for commercialization once we complete the project with the private sector. Over 30 farmers in Dambulla and Polonnaruwa are currently using the system on a regular basis and they have found the information very useful to make decisions.

"Gone fishing"- Studying metal | molecules | metal junctions with scanning probe microscopy

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The scanning tunneling microscope represents a powerful and flexible tool for forming and characterizing metal / molecule / metal junctions, down to the single molecule level, and this has greatly energized the field of molecular electronics in the last 15 years. In this talk, I will describe our group's work on developing single molecule redox switches, on the sensing of molecules down to the single molecule level using charge transfer complexation, and on characterizing the mechanisms by which various families of molecules conduct in these molecular junctions.

Plantation agriculture: a golden opportunity but need new dimensions to make them working

D. Seevarathnam

Consultant to Horana and Elpitiya Plantations

Agriculture is one of the most important sectors of the Sri Lankan economy. Even though its contribution to GDP declined substantially during the past three decades, it is the most important source of employment for the majority of the Sri Lankan workforce. Within agriculture, the major plantation crops of tea, rubber, and coconuts continue to figure prominently in the economy of Sri Lanka despite the fact that contribution of these commercial crops to GDP declined from 11.5% in 1970 to 5% at present. Tea, rubber and coconut being the major plantation crops in the country face considerable challenges due to high cost of cultivation due to increasing labour wages, lack of skilled labour, social changes of the communities engaged in plantation sector, marginalization of lands, conversion to other land uses, lack of technology development etc. In order to improve the plantation sector and in general agricultural development in the country, bringing innovative approaches to management is an essential aspect. This address focuses on changes in the management of plantation agriculture through innovative management approaches. Partners in progress, system of contract harvesting in the plantation sector, 'income assurance' as opposed to 'employment assurance' and value based management are discussed as the process of win-win situation for the country's plantation sector and agriculture in general.

National and global challenges for sustainable development

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The move towards sustainable development has picked up considerable steam over the past few decades. It has become a rallying call for international organizations in their efforts to promote a sustainable and cooperative development platform. This is evident especially when examining the "Sustainable Development Goals" project spearheaded by the United Nations. Sustainable development has therefore mushroomed into a multilateral endeavour, one built to promote a better future by encouraging global cohesion and international accountability.

Several nations, Sri Lanka included, have taken initiatives to incorporate sustainability into their growth strategies. While much progress has been made, issues that curtail advancement still remain. These issues are diverse and exist in both domestic and international settings. They have to be tackled to ensure that significant strides towards sustainability are made.

The address provides an overview of the Sustainable Development movement. Initially, it briefly delves into the history of the 'Sustainable Development' and 'Sustainability' movements. It then focuses upon issues that hinder international cooperation in promoting sustainability. Furthermore, the address examines Sri Lanka's efforts in addressing sustainable development issues. Different perspectives regarding the future of the movement, on a national and international scale, are also provided.

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Theme: Social Sciences and Humanities

Incorporating layered clay of Okanda and Kirinda ores into a poly (vinyl alcohol) matrix

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One of the eye catching areas in modern material science is the polymer nanoclay composites. Most of the local nanoclay demands are satisfied by imported materials. Sri Lanka is a country which is full of mineral resources including nanoclay. Clay is commonly used as a filler to enhance the polymer properties. As a result of composite formation, polymer will gain high barrier properties, chemical resistivity as well as an improvement in mechanical properties. This study was carried out to confirm the utility of such fillers in polyvinyl alcohol polymers. Raw soil samples were collected from Kirinda (81.2228 E, 6.2060 N) and Okanda 81.77092 E, 6.67650 N) areas at 50-70 cm depths. The collected clay samples were dried and subjected to a basic physical purification procedure. After confirming the presence of MMT type layered clays in local clay samples by XRD, these samples were subjected to further purification using sodium hexametaphosphate to remove quartz and other impurities. The chemical procedure was a trial and error method. The best purification cycle was selected by carrying out XRD and FTIR analysis after each stage of purification. The best purification level of layered clays was observed after one purification cycle with sodium hexametaphosphate.

Modification of partially purified layered clay was carried out to overcome the incompatibility between the PVA and the clay fillers. As the modifiers, 6-aminohexanoic acid and octadecylamine with 11-Aminoundecanoic acid were selected to do the comparison between the modifiers. Octadecylamine and 11- aminoundecanoic acid were used to give a co-treatment for the clay surface. Intercalation of modifiers to local and commercial layered clays was confirmed using XRD and FTIR studies. After confirming the intercalation of the modifiers, they were mixed with PVA. Composites of PVA and organically modified clay were prepared using the solvent intercalation method. The characterization of commercial and local clay PVA composites were carried out using XRD and FTIR. XRD studies showed that for all composites, the degree of crystallinity was improved compared to virgin PVA matrix. Additional diffraction lines due to crystalline domains appeared around 20° of XRD spectra. Differential Scanning Calorimetry (DSC) studies confirmed the presence of more crystalline domains in the polymer composites compared to pure polymer. In addition, DSC studies confirmed the improvement of the melting temperature of all clay composites compared to virgin PVA matrix.

Setting up a weather research and forecasting model for rainfall prediction in Upper Mahaweli basin

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Upper Mahaweli basin, which is the Mahaweli River sub-basin above the Polgolla reservoir, has a special importance in the water management of Sri Lanka. Reliable weather prediction in the basin is especially important for the operation of a number of reservoirs in the basin.

Simulating the natural atmosphere by using computer models is the main tool that is used for weather prediction. In this study, Weather Research and Forecasting (WRF) model is used to downscale global scale weather prediction data to obtain rainfall prediction over the Upper Mahaweli basin. WRF model is a regional weather forecasting model and it is a mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs.

The WRF model was calibrated using National Centers for Environmental Prediction (NCEP) reanalysis data for forecasting extreme rainfall in the Upper Mahaweli basin by selecting appropriate physics options of the model including microphysics schemes, cumulus parameterization schemes, land surface schemes, planetary boundary layer schemes, surface layer schemes and radiation physics schemes. WRF predictions were compared with the observed point rainfall data of selected gauging stations within the catchment. Observed point rainfall data were distributed to the same grid of WRF predictions by GIS based Inverse Distance Weighting (IDW) technique. After the comparison of WRF prediction with observed rainfall, a most appropriate physics combination was selected for rainfall prediction. Then the calibrated model was satisfactorily validated for few other rainfall events in the reservoir catchment.

NSSL 2-mom microphysics scheme, Kain-Fritsch cumulus parameterization scheme, CAM shortwave radiation scheme, RRTM long wave radiation scheme, YSU planetary boundary layer scheme, Noah land surface scheme and Revised MM5 surface layer scheme with other default physics options are the most suitable physics combinations for the Upper Mahaweli basin. This combination gave the least Root Mean Square Error (RMSE) of 11 mm at the calibration stage. In the validation process the model was run with optimized physics combination and RMSEs of 18 mm and 20 mm were obtained for two other extreme rainfall events. Calibrated WRF model is a useful tool for rainfall prediction in Upper Mahaweli basin.

Abstract No: 403   *Climate, Environment and Earth Sciences*

PAPER NOT PRESENTED

Impact of elevation and weed management methods on variability of Soil Organic Carbon stocks in an Ultisol

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Soil organic carbon (SOC) stocks play a significant role in regulating global warming.Generation of detailed maps of SOC stocks is necessary to assess its contribution for C sequestration at regional scale. Identifying environmental controllers of SOC stocks is a requirement for designing sampling schemes and detailed mapping of SOC stocks.

This study was conducted in Hapugasthanna Tea Estate in Maskeliya(WU1) to quantify the spatial variability of SOC stocks while investigating impact of elevation, soil properties and weed management on SOC stocksin a slopyUltisol soil-scape. Topsoil (0-30 cm) samples were collected from 44 locations using grid combined random sampling scheme.Three fields where herbicides applied in three months interval and three fields where herbicide free integrated weed management (HFIWM) practiced for three yearswere selected and samples were taken within each field. These samples were analyzed for SOC, bulk density, soil texture, saturated hydraulic conductivity, pH and EC.Organic carbon content and bulk density were used to calculate SOC stocks. Shuttle Radar Topography Mission (SRTM) 90m Digital Elevation Model was used to extract the elevation data.

Average SOC stock within the study area was 64.8 t ha^{-1}and coefficient of variation (CV=18.4%) indicated medium variability. Other soil properties(pH, EC, hydraulic conductivity)showed CVs from 9 % to 35 % indicating medium variability. Soil organic carbon stocks showed a positive correlation (r = 0.4) with bulk density and clay content. A negative correlation (r = -0.31) was observed between SOC stocks and elevation. Agreeing with this finding, interpolated map showed higher SOC stocks in low elevation compared to higher elevation. Variogram of SOC indicated moderately structured spatial variability. Average SOC stock in HFIWM fields (80.2 t ha^{-1}) was larger than herbicide applied fields (65.6 t ha^{-1}) (P = 0.07).

We found a medium level spatial variability of SOC stocks in slopy Ultisol soil-scape. Topography is one of the main controllers of spatial variability of SOC stocks. Thus, elevation and topographic attributes can be used as co-variates for sampling and subsequent mapping of SOC stocks. Weedicide free weed management enhances soil carbon sequestration in tea growing Ultisols.

Microbiological quality assessment of beach sand in Uswatakeiyawa, Prithipura coastal area, Sri Lanka

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Assessment of microbiological quality of beach sand has become one of the essential factors in many countries to reduce the risk on health of the bathers and others using these beaches for recreational activities. According to recent studies beach sand may act as a source of fecal pathogens for the overlying seawater. This study was designed to assess the microbiological quality of beach sand of a popular bathing beach at Prithipura, Uswatakeiyawa. Two sampling sites were selected with a distance of 150m and the samples were collected from April to September 2015. Microbiological quality of sand was monitored by testing for *Enterococcus* (as fecal streptococci -FS), coliforms, thermo-tolerant coliforms (as fecal coliforms- FC) and *E. coli* according to APHA and UNEP standards. *Staphylococcus aureus* and *Pseudomonas* were also monitored using Mannitol Salt Agar and Pseudomonas Selective Agar respectively. Temperature, salinity, conductivity, TDS and pH were measured at the sites to assess their effect on microbial growth.

Analysis of enterococci levels in sand was ranged from 112-400 MPN/100ml with an average level of 353 MPN/100ml. The average coliform content was 1111 MPN/100ml which was ranged from 40-1600 MPN/100ml. The average counts for thermo-tolerant coliforms and *E. coli* were 257MPN/100ml and 80 MPN/100ml respectively. Microbiological counts from two sites were not significantly different when subjected to 2-sample t-test using Minitab 14 statistical software. *Staphylococcus aureus* was absent in most of the samples, but the average level was 9.42×10^3 CFU/ml. *Pseudomonas spp.* showed a higher average value of 3.40×10^4 CFU/ml. The Pearson correlation test performed for all microbial and physical parameters indicated a negative correlation between *Pseudomonas* and temperature (-0.665, 0.036 and -0.774, 0.014) and a positive correlation between fecal coliforms and *E. coli* (0.625, 0.05 and 0.7, 0.024) at both sites. The average values of pH, conductivity and salinity were 7.89, 2.21 mS/cm and 1.1 ppt respectively.

Furthermore, the ratios of FC/FS ranged <0.7 – 4.0 but none of the samples exceeded 4.0 of which many were within the range of 0.7-2.0 providing evidence that a main and frequent cause of pollution is domestic animal wastes. However, one sample showed a value of 3.8 (FC/FS) which is an indicative of predominant human waste pollution.

Exploring the potential of proximal soil sensing for predicting soil fertility parameters

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Proximal soil sensing is an emerging technique having a potential to generate covariates for the digital soil mapping over time in a cost effective manner. This study investigates the potential of DUALEM-1S electromagnetic induction based proximal soil sensor to predict fertility determining soil properties in a Rhodustalf. The apparent electrical conductivity (EC_a) survey was performed in a commercial banana cultivation (4 ha) in Pelwehera (DL1b) using a DUALEM-1S sensor. The survey resulted in 8507 measurements of horizontal and perpendicular coplanar (HCP-subsoil and PRP-topsoil sensitive, respectively) EC_a measurements. Topsoil (0-30 cm) samples were collected from 43 locations. Soil samples were analyzed for texture, organic carbon, plant available (Av.) nutrients: N, K, P, Ca, Mg, Zn, Cu, Fe, Mn, pH, effective cation exchange capacity (ECEC) and electrical conductivity (EC). EC_{aHCP} and EC_{aPRP} data showed a high correlation (r = 0.9) indicating comparable top and subsoil properties. EC_{aPRP} measurements showed strong correlations with clay % (r = 0.6), sand % (r = -0.6), Av. Mg (r = 0.7) and Ca (r = 0.7). Spatial variability of properties was investigated using variogram analysis. Available Mg, N, Fe, Mn, P, K and Ca in the topsoil showed a strong spatial dependence with a relative nugget effect less than 25%. Principal component analysis (PCA) was used to assess the potential of EC_a to serve as a covariate to predict other soil physiochemical properties. The PCA reduced the dimensionality of the data set into five principal components (PC). PC1 attributed 32% of the variability which highlighted the relationships among EC_{aHCP}, EC_{aPRP}, sand, clay, ECEC, Av.Ca and Mg. PC2 attributed 19% of the variability highlighting the relationships among Av. Zn, P, Cu, Fe and EC.

This study revealed a strong spatially structured variability of soil fertility parameters which can be used to optimize soil management practices. Proximal soil sensing can be used as a promising tool to predict a majority of soil properties: sand, clay, organic matter, Av. Mg, Ca, Fe, P, Cu and Zn in Rhodustalf, the most prevalent soil great group in the dry zone.

A stringent eco-labeling scheme to rule out greenwashing from Sri Lanka: suggestions for a legal framework

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As present day consumersare remarkably inclined to make their purchasing decisions based on the product's impact on the environment, labeling goods and services according to ecological criteria has become a popular practice around the world. Hence, among manifold policies formulated in furtherance of sustainable development, eco-labeling or green labeling has seized much attention.

However, an eco-label which merely green-washes a product could mislead consumers who intend to minimize the adverse environmental impacts by purchasing environmentally preferable alternatives, even at a high price.Specially, the absence of a nationally accredited eco-labeling scheme could trigger a tendency of using self-claimed eco-labels as a marketing trick to lure the environmentally conscious consumers to the greenwashed products. Therefore, in order to protect the consumers who are inclined to make their choices more on ecological grounds than on price signals, introducing a well-regulated eco-labeling scheme is of utmost importance.

This qualitative research is basically aimed at understanding the concept of eco-labeling and its positive outcomes. Moreover, it highlights the dearth of a legal framework on eco-labeling in Sri Lanka and the significance of introducing a nationally accredited eco-labeling scheme which operates there under. Further, based on a comparative study on Germany, India, European Union and Singapore which have respectively brought up nationally/regionally accredited eco-labels such as Blue Angel, Eco-mark, and EU-Flower, suggestions for a legal framework are brought up in order to indicate reliable information on the environmental impact of a product to the consumer. Thus, the propensity towards greenwashing can be ruled out of Sri Lanka and foster its sustainable development.

Rapid assessment to determine seasonal variation of water quality in Negombo lagoon

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Water quality parameters are important factors which help to reveal the current environmental conditions of coastal marine waters. In addition temporal trends on the marine ecosystems also can be identified with the help of water quality measurements. Therefore, the main objective of this study was to understand the status of water quality of the Negombo Lagoon during the wet and dry seasons in 2015. The physico-chemical parameters were measured in 26 sampling locations in Negombo lagoon. In-situ analyses were carried out for pH, conductivity, salinity and total dissolved solids (TDS) measurements using a portable meter (ORION STAR A329, Thermo Scientific). There were slight variations of pH during dry (ranged 6.6 to 8.6) and wet (ranged 6.4 to 8.1) seasons. The electrical conductivity (EC) and salinity values were also high during dry season (13.6 to 55.4 mS/cm) and (7.2 to 32.1 ppt) respectively. Similarly, in the wet season sampling EC and salinity levels decreased (ranged 0.1 to 31.1 mS/cm) and (ranged 0.1 to 18.2 ppt) respectively. The average values of total dissolved solids were high in dry season (19.3 ppt) and relatively low in wet season (6.5 ppt). The EC, salinity and TDS values were relatively high in all the locations during dry season sampling, because the lagoon was undergoing drying and salts were accumulating through evaporation. According to the results of the Negombo Lagoon, pH and nutrient parameters are within the accepted limits for the fish and aquatic life according to the proposed inland water quality standards of the Central Environmental Authority (CEA), in 2001. In conclusion, the results from this study showed that physical water quality parameters such as salinity, EC and TDS showed strong seasonal variations amongst stations. The only identifiable source of water loss from the lagoon is by evaporation and freshwater inflow through several canals. The evaporation seems to be a major controlling force for these chemical parameters in the lagoon. The effects of season and runoff are the two major causes of variation in water quality but human activities have interfered with this cycle and have exacerbated both wet and dry period extremes. In this study, three main parameters were identified as being principle in influencing the observed water physicochemical parameter distribution in the study area. These are salinity, pH and conductivity.

Role of Muslim women in decision-making: a case study of Mawanella

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This research aims to evaluate the Role of women in independent decision making from family to the society in *Mawanella* and to analyse the disparity between Islamic texts and the popular practices.

This study was carried out within a diverse Muslim population of 598 families. Primary data was collected using a questionnaire survey, in-depth interviews with key informants and case studies. The structured questionnaire survey was conducted with 100 respondents. The sample for the questionnaire survey was selected through the stratified random sampling method based on gender, socioeconomic background, education level and affiliation to religious organisations.

The purposive sampling was used for in-depth interviews that provided qualitative data regarding the individuality and status of women. The case studies were done using snowball sampling in order to obtain more subjective aspects of the position of women in decision making.

The results and findings of this study revealed that women despite their social and economic status prefer to be financially independent. Though women are respected, they are often deprived of making decisions as individuals, regarding crucial life events such as choosing a partner in marriage, continuing their higher education and opting to work. It was also found out that the women's participation in social activities is also limited. The decisions regarding the society are often made by men and women are seldom consulted.

Although the pure Islamic teachings recognise women whether married or unmarried as individuals of self-worth, the popular Muslim culture seldom allows women to enjoy that properly. The measures to minimise the blockades for women moving forward should seriously be taken into consideration. Islamic movements must reconsider broadening of their vision and hierarchical structure accommodating more women's participation and on diverse fields.

As one-half of the community, women should not be deprived of the right to take part in the decision-making process of the *Mosque* nor in participating in activities of social interest. The researcher suggests that women representation in the form of an advisory committee in *Qazi*courts and Mosques would be a good move towards enabling social mobility of women.

Unfortunately, as our society relies so much on the power and strength of the authority of men, there has been a continuous struggle among women even for their authoritative rights enshrined in the Quran and authentic hadiths.

The researcher feels that it is important to identify these types of common problems and dilemmas that a Muslim woman faces due to the un-authoritative customs and beliefs of the Sri Lankan Muslim society and try to bring out the 'voice of the voiceless' by trying to figure out how they feel towards the capitalization of men in the forefront even when many women are much capable of discharging the same duties without any disruption.

Influence of ethnicity on counseling in the Divisional Secretariats in Sri Lanka

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The study was conducted with 30 participants, ten counselors and twenty clients in five divisional secretariat offices in Sri Lanka. There were three Sinhala, Tamil and Muslim counselors and one Burger counselor. Seven clients were Sinhala, six were Tamil, five were Muslim and two were Burger. There were twenty women and ten men.

Both quantitative and qualitative measures were conducted. Data was collected for quantitative analysis using a questionnaire developed along Toronto Empathy Questionnaire.The total score of the questionnaire measured the overall empathy of the participants. The four subscales measured participant's empathy towards Sinhala, Tamil, Muslim and Burger counselors separately. The questionnaire was completed by all 30 participants. Semi structured interviews were conducted with four counselors representing all four ethnic groups and six clients again representing all four ethnic groups to elicit in-depth information using qualitative analysis.

Overall, the participants were positively empathic with a mean score close to the answer 'often' indicating that for most situations they were 'often' empathic. All ethnicities were most empathic towards their own. Preference for their own ethnicity continued for counselors and clients. All four counselors were very clear about being proud of their own ethnicity and seeing it as the most positive. They had positive comments about clients from their own ethnicity and overwhelmingly preferred to work with them. Their comments were not as negative towards clients of other ethnicities compared to their comments about other ethnicities in general. Clients too liked their own ethnicity the best and had mixed or negative reactions towards the other ethnicities. They preferred counselors from their own ethnicity but were willing to work with other ethnicities.

In conclusion, participants were positively empathic overall but were most empathic towards their own ethnicity. All counselors and clients were proud of their own ethnicity and had mixed reaction to other ethnicities. They preferred to work with similar ethnic dyads but were willing to work with an ethnically other.

Buddhist monastic architecture in ancient Sri Lanka designed to fit spiritual development

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The objective of this research paper is to highlight the religious utility of Buddhist monastic architecture in ancient Sri Lanka which was typically planned to fit spiritual development. Buddhist Monastic setting and planning in ancient Sri Lanka seem to be a particular subject which supported spiritual development. Though a considerable amount of research work has been done on this subject, there is a need for a supplementary study on typical setting and design of monasteries fit for spiritual development of monks. The aim of this study is to complete this shortcoming.

The research methodology of the study is based on the data collected from literary and archaeological information involving library research and field study. The collected data will be analyzed and compared with the literary evidences.

Hypothetically, it seems that residences of monks in ancient Sri Lanka were built to suit the spiritual development of meditators. In the field of Asian architecture, Buddhist monasteries were planned and setup to facilitate mental development. They are not only symbolic but are also representative of the inner lives of monks who lived in these monasteries. Designing of buildings for monks fosters the attainment of the ultimate goal in Buddhism. These plans reflect inner life of monks. The Papancasȁdani and the Visuddhimagga consist of the following types of monasteries which were recommended by the Buddha. They are *lenani* or abodes allowed for monks: *Vihara, Addayoga, Pasada, Hammiyam, Guha, Lena, Kuti, Kutagara, Mala, Upatthanasala.* In this study these types of plans will be closely examined.

Attitudes of academics towards self-archiving: a situational study of the University of Peradeniya

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How to increase the Faculty participation in self-archiving has been one of the key topics in the discussion and operation of institutional repositories (IRs) at present. The usability of an IR primarily relies on the amount of its content material, which becomes available through self-archiving of research outcomes by academic scholars in the Faculty. The main objective of this study is to examine the awareness and attitudes on self-archiving practices of academic scholars in the University of Peradeniya (UOP). A survey method was adopted and the questionnaires were distributed among all permanent academic staff members in the UOP on May, 2015 and out of 751, 279 duly completed questionnaires were received making a 37.1% response rate. With regard to the awareness of self-archiving, only 25% of the academics who participated in the survey mentioned that they are aware of it while 34% mentioned that they have not heard about self-archiving and 112(40%) did not respond to the question. As far as the experience in self-archiving is concerned, only 13% of the respondents are exposed to the self-archiving practices, while 45.5% did not have experience and only 8.6% mentioned that they have been self-archiving their work for 1-3 years. Of the respondents, 11.47% learnt about self-archiving while surfing the internet, followed by 5.38% came to know from professional friends or colleagues. With regard to the self-archiving materials, 29% of the scholars who responded to the survey prefer to self-archive conference papers rather than research reports and post print articles (23.7%). Findings suggest that most of the scholars (74.5%) who responded to the survey are unaware of self-archiving practices or even have not heard about it. Overall, only 13% of respondents have had exposure to self-archiving practices and most of them learnt about self-archiving from the internet and the most preferred format they would like to self-archive is conference papers. Based on the conclusions, it is recommended to conduct seminars and workshops to create awareness and on understanding of self-archiving among the university academics.

Use of library resources by the Humanities and Social Sciences undergraduates: factors associated with information seeking in the main library of University of Peradeniya.

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The purpose of this study is to determine the factors that are associated with the use of library resources among undergraduates and their relationship. A survey research method was applied. A close-ended questionnaire developed by Mohammadamin, Abrizah and Karim (2012) was used with the Likert Method. After the pilot survey conducted in February 2015, the main survey was carried out in September 2015. The sample was selected from the 2nd – 4th year undergraduates in different departments in the Faculty of Arts, University of Peradeniya and 209 cases were selected by considering ten percent from each academic year. The study revealed the following results. Out of the total sample, 80.3% of the library users were female and less than 20% were male. According to the study, 80.8% used the Sinhala language, 15.4% used Tamil and only 3.8% used English as the medium of communication. Regarding the use of library resources, less than 50% of undergraduates used databases, electronic information media, ICT and other resources in the library. More than 50% undergraduates agreed that they were unfamiliar with information resources and that they feel anxious when using them. Another factor identified was the use of computers: the Internet barrier and ANOVA indicated that there weren't any significant differences during the academic year. Another factor measured was the barriers relating to the library: from that scale, 41.3% indicated that the temperature inside the library is uncomfortable. Moreover, 45.7% have anxiety when searching for information. With regards to the factors related to technology, 51% are suffering from mechanical issues during information seeking and another factor they have difficulties with is generating topics for search (41%). The study indicated that a great majority of the students are still in a critical condition in terms of the use of library facilities and services available in the university. Students need more awareness of the library resources and it is necessary to provide hands-on training in the use of OPAC, computers and internet resources to get reliable results when searching for information within the library. Therefore, it is necessary to conduct relevant and useful user education programs based on the consideration of the study. Moreover, other awareness methods are also needed to promote the use of the library resources for students' academic endeavors.

Misery in spite of happiness: critical problems of poverty alleviation programmes in Sri Lanka

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Welfarism, has long been considered as a major political ideology of administrative programs in the so called Third World societies. Regardless of the political dimensions used, the welfare approach must be perpetuated to ensure social development in these countries. However, social protection and security policies intended to alleviate poverty in Sri Lanka that were introduced with highly administered government interventions were questioned since interests of some societal segments were not addressed satisfactorily.

The objective of the study is to understand some culturally defined socio economic and political problems relevant to specific social segments (such as estate sector) when poverty alleviation social policy programs (here "Divineguma Programme" is concerned) are carried out with the intention of social development in Sri Lanka. In order to address the research problem specified, phenomenology was employed in accordance with the grounded theory approach. "Labukele Estate" in Nuwaraeliya District was selected as the research area. Accordingly, using unstructured interview guideline, 20 respondents were interviewed and 2 case studies were conducted. Collected data was analyzed using thematic analysis.

Poverty alleviation programs initiated as a social welfare policy program in Sri Lanka have encountered several complications for many years without any appropriate and pragmatic solution. Resource leakages due to complex bureaucracy and inappropriate targeting with controversial conditionality are uppermost of the critical problems. So far these problems have been identified in an economic and administrative sphere; but this study asserts that these problems are amalgamated with rigorous cultural determinants. On the other hand, intergenerational dependence of family members, government policy changes and cultural resistance, widely targeted policy approach followed by the neglecting of specific cultural pockets, lack of administrative interventions due to culturally defined presumptions, deeply rooted cultural barriers, protracted poverty trap can be considered as major problems of social welfare policies in Sri Lanka.

It is not an easy task to compile social policies aiming at alleviating poverty since expected social development get subsided due to unexpected problems specific to the culturally defined Third World societies. Therefore, administratively programmed and culturally specified welfare policy programme would be the best possible approach to address the above problems.

Issue of Pedophilia; is it a mental disorder or a sexual orientation?

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Pedophilia, which is considered as a mental disorder, can be simply defined as the fantasy or act of sexual activity with prepubescent children. A "pedophile" is a person who has a sustained sexual interest towards children, generally aged 13 or younger (APA, 2013). The American Psychiatric Association (APA) considers "pedophilia" as a mental disorder in its Diagnostic and Statistical Manual of Mental Disorders since 1968. In DSM-5, "pedophilia" has been grouped with other paraphilia. Research studies have clearly shown that pedophilia is a result of neurobiological, environmental, and psychological facts.

Though DSM-5, ICD-10 and other manuals of mental disorders consider pedophilia as a mental disorder, a considerable number of research studies try to prove that pedophilia is a "sexual orientation." Sexual orientation is a term used to describe a person's patterns of emotional, romantic, and sexual attraction - and a person's sense of personal and social identity based on those attractions. There are three sexual orientations.

Heterosexual: attracted to individuals of the opposite sex
Bisexual: attracted to members of either sex
Homosexual: attracted to individuals of one's own sex

Considering several research findings, many psychiatrists, clinical psychologists, forensic psychologists, scientists etc. had to accept that pedophilia is a sexual orientation. However, the idea that sexual attraction to children is an "orientation" is highly controversial as it suggests that offenders cannot change. Further, social and cultural opinions on pedophilia remain the same and so does the law. So, we are left with the alarming question: if someone is born pedophile, what should society do with him or her? This issue should be addressed soon and authorities have to take a decision soon as a considerable number of people in the world are pedophiles. Using a literature review of the research studies done on "pedophilia" the topic "Issue of Pedophilia; is it a mental disorder or a sexual orientation?" will be critically discussed.

Invasion of Alexander the Great and the emergence of hybrid cultures in the east

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Alexander the Great became the master of the Achaemenid Empire after defeating Darius III in 331 BC. Then he secured the Achaemenid satrapies of Baktria and Sogdiana in Central Asia. In 327 BC Swat and Punjab were annexed to his empire. He had to abandon the expedition to further east and had to turn homewards when his army refused to proceed. While some of the soldiers remained and settled in India and in the other eastern territories having intermarried with the locals, some joined Alexander in his homeward journey. The Greeks who remained and settled along with the people in the newly founded cities, colonies and provinces led to stimulate the spread of Hellenism in the eastern territories. When Alexander died in 323 BC his empire was divided among his generals. When these generals began to consolidate their territories it further led to create new hybrid cultures (mixing Hellenic culture with the local cultures) and/or to consolidate the existing ones.

This study intends to critically examine the impact of the conquests of Alexander the Great in spreading Hellenism in the East, and how it led to the establishment of hybrid cultures that later swelled into separate political centers. In this process, first the conquests of Alexander, with reference to the establishment of settlements and provinces, and setting up of garrisons will be examined along with Alexander's setting up of new cities. Then, the focus will be shifted to examine the impact of Alexander's conquests on the East with attention to the setting up of hybrid cultures.

It can be concluded that the scant Hellenism in Asia gained a revival with a great dynamism due to the invasion of Alexander. Gandhara and Matura art and architecture are clear manifestations of hybrid cultures that emerged from the fine amalgamation of East and West.

Buddhist perspective on religiosity and spirituality as shown in *Mahāyañña-sutta*

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The relationship between religiosity and spirituality is a controversial issue. Even though humankind does not deviate from the influence of religion, its impact on their daily life-style is declining. Now humankind is equipped with better scientific explanations to clarify what was unclear to them and technological enhancements which can solve many of the problems. The present study will elaborate how Buddhist teachings can give insights to enrich this dialogue.

The present study is primarily a textual study based on an Early Buddhist discourse namely, the *Mahāyañña-sutta* in *Sattaka-nipāta* of the Buddhist canonical text in *Pāli* language, *Aṅguttara-nikāya*. (Part IV, pp.41-46.)

The discourse begins with the preparation of Brahmin *Uggatasarīra* for a great sacrifice in which hundreds of bullocks, heifers, goats and rams were on the way to be sacrificed. Replying to a Brahmin's question, the Buddha explained how a sacrifice becomes beneficial. Proper maintaining of three fires can make a sacrifice great: the fire of those who are worthy of gifts, the fire of the householder and the fire of those who are worthy of offerings. In fact these three kinds of fires were not new to the Brahmin. The Buddha only redefined Brahmanism's terminology by allotting new meanings to a set of already existing terms. Religion is characterized by its authoritative nature and emphasis on its followers' obligation to perform rites. In Brahmanism, sacrifices were performed for the purpose of achieving a prosperous life, although there is no causal correlation between a sacrifice and a good life. In this way, religion defends its mysticism. On the contrary, the Buddha's interpretation of three kinds of fires paves a way to a much candid explanation with a clear practical basis. If anyone treats others in proper ways, this would create causes and conditions to live in harmony with the society. There is nothing clandestine in this explanation.

Spirituality, unlike religiosity, does not represent an inviolable bondage to an external authority. It comes from within. As pointed out in the *Mahāyañña-sutta*, one can be spiritual even in his or her interaction with the society. This might be a starting point to break the wall between secularity and spirituality, that is, towards a "secular spirituality".

PAPER NOT PRESENTED

Rearticulated caste identity in the context of war

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With the end of the nearly three-decade long Sri Lankan civil war in 2009, the socio-cultural consequences of war require a critical introspection on caste and its hegemonic construction. In this research I examine how war has impacted caste and especially the hegemonic *Vellalah* identity construction. War entails migration, brain drain, denial of dissent, internal displacements, economic embargo, the loss of land, assassinations, disappearances, killings, abductions, violations of social-cultural norms and even internecine wars. These are considered widespread abnormalities within the grammar of war.

The data for this study focuses on the Jaffna district and is drawn from purposive and snowball sampling. My analysis relies heavily on how *Vellalah* and depressed castes describe their experiences of the war. I also conducted several semi-structured interviews, focus group discussions and document analysis over a period of three years from 2006-2009.

War as an embodied experience meant that everyone went through similar but not the same experience in an enforced war zone. I argue that people's experiences of war depend on individual involvement in politics, their placement in already existing socio-economic strata and their direct experience under firing or shelling. The *Vellalah* identity evolves from agriculture and the accumulated assets being settled in one place for the first time shattered by the war. Internal dislocations forced Jaffna Tamils to be together physically in temples, camps, schools and public places. This gave a space for all to go through similar experiences. The war created a temporal transition and adjustments in caste practices and in Vellalah identity. The changes remained for a short time, but a radical transformation in terms of caste *(Vellalah)* identity occurred. Vellalah identity structures deteriorated without immediate consolidation of a new structure, although caste sensibilities never disappeared and continued to reassert themselves even with Vellalah becoming a numerical minority in Jaffna. Vellalah dominance has not disappeared, they still own much of the land, and control local politics, but the arenas that formerly demarcated their identities have eroded with massive Vellalah emigration from Jaffna.

Do university libraries in Sri Lanka use social media as a marketing tool?

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The development of Information and Communication Technologies and Web 2.0 technology created the opportunities for the librarians to reach their patrons by moving beyond its physical boundaries. As one of the main communication products of Web 2.0 technology, social media plays a vital role on library marketing. Libraries worldwide are using popular social media platforms as a digital marketing tool. Therefore, the objectives of the present study are to: assess the availability of social media platforms to academic libraries in Sri Lanka and to identify the types of social media channels used by academic libraries in Sri Lanka. The universities and higher education institutes accredited to the University Grants Commission (UGC), Sri Lanka were selected as the study sample. There are 15 universities accredited to the UGC, Sri Lanka. The social media accounts of each library were accessed through researchers' own accounts to make sure whether these accounts were created by the particular library. Since this research focused on the availability of libraries on social media, the contents of the social media accounts were not considered. Two libraries Facebook pages were mentioned as 'unofficial' and they were omitted from the study. Finally data were analyzed using Microsoft excel 2010. Results revealed that, nine out of fifteen academic libraries have at least a single account in any type of social media platform. However, of those nine academic libraries (60%) which have at least a single social media account, four academic libraries (40%) provide links through the library homepage. Facebook is the most widely used social media site for marketing university libraries in Sri Lanka. Eight out of fifteen university libraries (53.3%) use Facebook to promote their library and related activities such as events, new arrivals and new services. Only two university libraries (13.3%) published their details on Wikipedia encyclopedia. One library created YouTube (6.7%) and Google+ (6.7%) accounts to market their library services. However, none of the university libraries use Twitter, MySpace, Pinterest, Instagram, Flicker, LinkedIn or Blogs for promotional purposes. Therefore, libraries must pay their attention to developing strategies to use social media more effectively for library marketing.

Examination of bibliographical standards followed by Sri Lankan authors: a case study of the subject related books acquired by the main library, University of Peradeniya

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Book publishing is indispensable in the knowledge society. The details of title page, ISBN, Copyright, Cataloguing In Publication (CIP) data, year of publication, place of the publication, publisher, page numbers are essential bibliographical information for publishing a book. When librarians acquire books it is observed that some authors/publishers do not follow basic bibliographical requirements or standards for their publications. Missing of this information affects the preparation of the library catalogue, compilation of the library databases and other documentation. This paper addresses these issues with specific reference to publishing of books by Sri Lankan authors. The main objective of this study is to identify the authors' behavior in using bibliographical information in their book publishing.

Content analysis was adopted for this study. The guideline for authors prepared by the National Library and Documentation Services Board was selected to find the basic criteria and 17 criteria which are the most important criteria to consider in publishing of books have been identified. Out of the subject related books which were acquired by the Main library in January and February 2016, 51 titles were selected. The data was analyzed using descriptive statistical methods.

All the authors have clearly understood how to use the title and author on the title page. The details of the publisher have been included by 97% of the authors, but the place of publishing was properly indicated only by 30%. CIP data had been included only by 69% and only 23% of the authors had added the details of the copyright. The ISBN number had been included by 94%. Using of a standard referencing style is essential in subject related books, and according to this survey 69% have not followed a standard referencing style. A total of 31% followed various types of reference styles. According to the above findings, it was revealed that there is a positive trend in the use of bibliographical standards in publishing of books but there are certain inadequacies. All libraries should have authors' guidelines to make them aware of basic bibliographical information which should be included in their publications. It is necessary to encourage authors to follow ISO Standards.

PAPER NOT PRESENTED

Criteria for evaluating good and bad

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In a monopoly of philosophical definitions about the ethics of good versus bad, Buddhist teachings present a unique perspective through the terms of kusala-akusala and pu¤¤a-pàpa. These teachings interpret good and bad from a fundamental ethical standpoint. Further, kusala-akusala is a unique teaching of Buddhist philosophy that paves the way beyond pu¤¤a-pàpa. All good and bad actions are preceded by mental functions. In Buddhist philosophy, the intention of an individual who is responsible for his own actions is a critical factor in determining what is good and bad. The Buddha has elucidated several criteria for evaluating good and bad actions. For instance, in the Kàlàma-sutta of the Anguttara-nikàya, the Buddha asked the Kàlàma-s to put aside everything that teachers had told them and presented clear criteria with which they could evaluate good and bad according to their conscience. In the Ambalaññhikàràhulovàda –sutta and the Bàhitika-sutta of the Majjhima-nikàya, the Buddha has presented a cognitively unique criterion for evaluating good and bad. All the Buddhist criteria expounded by the Buddha are centred on humanity and they can be accepted by all religions and people all over the world as a universal set of ethics. Such criteria need to be the template upon which all ethical decisions are made so that individuals can be confident that such decisions are founded on a deep and sound philosophical framework that is consistent and has stood the test of time. The purpose of this paper is to evaluate the criteria used for evaluating concepts of good versus bad using the ethical framework of Buddhist teachings.

Investigative Study on Synonyms used to describe women in Sigiri Graffiti

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Sigiri graffiti is one of the main archeological resources that shows that the Sinhalese have quite a long history of writing poems, going back to the 8th century. Paranavitana has discovered 685 graffiti on the mirror of wall. Many of those verses include advanced poetic features and specify that Sri Lankan people have been good at writing poems for long time. This research is not about discussing the Sigiri graffiti or the history of Sinhala poetics, but it is about the synonyms used by the authors to describe women. The objectives of the research are to find out the kind of words that were used by the poets to describe Sigiri women, their reasons to use different kind of words, and to examine how these words were formed. The research is based on literary resources. *Sigiri Padyavaliya* is used as the primary resource and some dictionaries and judgments of some scholars are used as secondary resources. Gorgeous Sigiri women were the main theme of most Sigiri graffiti. Thus, many words have been used to eulogize those women. According to the meaning, these words can be categorized into a few groups as follows:

Word that describe the beauty	Word that describe the	Word that describe the ages	Word that describe the status
සුරඟනන්	මියෙලඩි	අඹ	හිමබයුන්
දිවසරන්	මින්දිබියො	සවනක	මිඩියන්
රන්වනැන්	අසද්බඳ	අම්බයුක්	පැවැසි
කත	ලිය	ගැහිනින්	
දිග්නෙත්	සිරි	උබයයේ	
එගැස්	සිලිලි	උබි	
හෙළිල්ලඹ	සබන්දින්	ළඳුන්	
මිලැස්න	පියබන්ද්	අළි	
වනිති	වරඟනන්	අග්නන්	
යහදැන්න		යොවනුන්	
නිලුපුල් ඇසන්			
සම්වනක්			
කෙල්ල			
කලක්			
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People from different social categories such as royalties, government officers, ordinary people, monks and nuns have written these poems expressing their personal views. According to the research, most of the ordinary people have loved to see Sigiri women aesthetically. In addition to this, everyone tended to label women according to the age and these words have been used by women, wives and monks in their writings. Words such as *ambu, abi, Ambuyuk, abuyui, gæhænin* indicate the meaning of 'wife' while the younger girls were identified as ළඳුන්, යොවනුන්. High class People, officers and reverends have discussed the characters of women while ordinary people indicated the status. Some of these words were formed with the influence of Pali and Sanskrit. Sigiri graffiti belong to a transitional period in the Sinhala language. So, many optional words have been used in Sigiri graffiti. In conclusion, it can be suggested that Sigiri poets have mentioned many words to describe Sigiri women according to their personal feelings and personal status. These words denote women's beauty, characters, ages and status. Mother languages such as Pali and Sanskrit have affected some words when these were formed. And also, many optional words have been used for a word because of language evolution.

Protecting the protectors- broadening the definition of Human Rights Defenders

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In the past two decades the world saw the beginning of a new era of human rights which created changes in the understanding and perception of human rights'. Within this context "Human rights defenders" emerged as a heated academic debate all over the world. Within the Sri Lankan post war context this term has been used on several occasions yet without any reference to the ordinary civil society, which is an essential category of human rights defenders. This research focuses on exploring the definition of human rights defenders and seeks to discuss how the term could be used as a protection mechanism towards building a sustainable future.

A combination of primary and secondary qualitative research methods were deployed. The research, at the outset, involves a comprehensive domestic and international literature review. Coupled with this a series of in-depth, semi–structured interviews carried out with human rights defenders to understand the protection mechanisms available under the United Nations protection regime.

The UN General assembly in 1998 passed the 'Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms', which became the main instrument and agent of human rights defenders. It is clear with the relevant findings that the definition of a human rights defender must be broad and inclusive. This will result in a vast majority of civil actors like trade unions, student unions, journalists, academics and a whole host of other actors working for the rights of the others to be recognized as human rights defenders. This will in turn positively affect their human rights activities under the human rights regime. It will strengthen the civil society against social injustice and to drive the society towards building a sustainable future.

Vulnerable situation of agency-hired casual workers in the business logistic field in Sri Lanka

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Business Logistics Field (BLF) is a field that is an amalgamation of various business functions. It requires thousands of workers as it is multifunctional in nature. To fulfil the usual turn over, the logistic companies hire 'casual workers'. The new trend in the casual labour recruitment is "recruiting employees via labour supply agencies". These agencies are called in layman term as "manpower agencies", and they come under the category of 'fee-charging employment agencies'. The study considered the restructured category of employment called "Agency-Hired Casual Workers" (AHCW).

A combined research design was used for the data collection assisted by questionnaires and semi-structured interviews with field and a library surveys and both local and international legal instruments were used.

The field survey reveals that there is a huge demand for AHCW in the BLF. It falls under the sub category of 'atypical employment' and there is a high potential for having more vulnerabilities in BLF especially in the warehouse operations for the AHCW. The library research shows that the existing labour laws in the country are insufficient in recognizing the category of AHCW in BLF as well as in the supervision of legal provisions on claiming insurance on behalf of them. There is a salient unawareness on the insurance policy of such workers. Even though there are both international and local laws related to the subject, there is no proper system of identifying AHCW.

Finally the study emphasizes the requirement of identification of the BLF as a specific working field due to its complexity and hazardous nature in particular functions, AHCWs as a sub category of the 'atypical employment' by legislation and the quick ratification of the C121; Employment Injury Benefits Convention, 1964 [(No. 121) and C024; Sickness Insurance (Industry) Convention, 1927 (No. 24) for the betterment of AHCWs.

Finally, the research confirms the hypothesis 'the existing labour laws do not provide any sufficient recognition and coverage on the insurance policies of agency-hired casual workers in the Business Logistic Field in Sri Lanka'.

Naming speed, phonological awareness and orthographic knowledge in children with and without dyslexia

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"Reading" can be identified as a complex cognitive process which leads people to become complete persons. Generally, children can acquire the ability to read when they are formally taught to read and write. But there is a special condition which prevents children from acquiring reading ability in spite of their average or above average intelligence, adequate reading environment and intact sensory organs. This condition can be identified as developmental dyslexia. The present study focuses on the reading ability of children with and without dyslexia. According to previous research findings, the reading ability can be measured through rapid naming skills, phonological awareness and orthographic knowledge of children. In this study major reading measures; Rapid Automatizing Naming (RAN), Phonological Awareness (PA) test and Orthographic Awareness (OA) test have been administered to 25 dyslexic children (age 8-14 years) and 24 aged-matched control group. I hypothesized there is a significant difference in children with and without dyslexia on reading measures, there is a significant relationship between the scores of RAN, PA and OA and RAN,PA and OA are important as predictors of reading achievement. Both accurate answers and time taken for completing tasks were analyzed by using the t-test, Pearson correlation and stepwise regression. The results revealed that there is a significant difference in children with and without dyslexia on reading measures other than colour naming, number naming and syllable reversal tasks. There is a significant negative correlation between RAN, phonological awareness and orthographic awareness scores. The results also showed there was a significant positive correlation between phonological awareness scores and orthographical awareness scores. The stepwise regression analysis showed that orthographic awareness and RAN-numbers were best predictors for word reading and OA for non-word reading in dyslexic children. Further, Phoneme deletion time taken was the best predictor for word reading and RAN-letters were the best predictor for non-word reading in non-dyslexic children.

According to the results of the present study, the hypotheses stated were accepted and results are matched with the findings of previous studies other than RAN –colours, number and syllable reversal.

Multifarious replicas in metacognition and mindfulness

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Pedagogy has been influenced by studies on cognitive psychology in recent decades leading research towards metacognitive approaches. Metacognition and Mindfulness have been standings used in cognitive pedagogical approaches with identical interpretations. Metacognition being a concept aligned with western scientific approach received liquidity while mindfulness being a Buddhist philosophical approach to the mind does not interact much in research. The study attempts to materialize a taxonomy for the concept: mindfulness in Buddhist philosophy and to contrast it with the taxonomy of metacognition thereby investigating the replicas of the two.

Taxonomy of metacognition is constructed in twofold dimensions: metacognitive knowledge and metacognitive skills. Metacognitive knowledge is a construct of three super categories: declarative, procedural, and conditional metacognitive knowledge. The second core-component: metacognitive skills consists of regulation of cognition and executive functioning/metacognitive experiences. Mindfulness in contrast encapsulates three developmental stages in category level: remembering and recollecting *(sati),* alertness *(sampajana)*, and ardency/compunction *(atappa/ottappa)*. Remembering and recollecting consists frames of references: body, feelings, mind and mental qualities at super-category level. Alertness being the second category involves three super-categories and occurs between the mind and activities in the body as they are happening. Ardency/compunction includes the desire to avoid the unbeneficial coupled with desire to stimulate the beneficial. Such taxonomies remain the material for semantic analysis in contrast in category, super-category and sub-category levels.

The quintessence of both constructions: metacognition and mindfulness remains identical paving category level replicas in reflection or remembering. The sub-category, super-category and category levels remain judiciously identical with distinctly agreed semantics. Thus the two taxonomies remain exact in their alignment in sub-category, super-category and category levels that function in sequence constructing either in metacognition or mindfulness. The replicas of semantics in the two taxonomies are abundant. The originality of taxonomy of mindfulness stands due to the mediating orchestration stage: alertness correlating body with the mind which manipulates the body. Taxonomy of Metacognition does not inevitably include such venture of orchestration, thus lacking a scheme of synchronization.

Studies oriented for calibration of such taxonomy for applied concerns in to the fields such as education, learning, cognitive psychology, pedagogy, psychopathology are prescribed.

War literature and comparative politics

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War is one of the social problems that the global society is facing today. War has plagued humanity since time immemorial. Many countries have gone through this experience at some point in their peoples' lives. It can bring immense emotional trauma and suffering to the people left behind by the dead. This paper is committed to explore the ramifications of both inter- state and intra-state wars and its political realities which took place in different continental settings. The paper revolves around central figures that were lead into war and war zones sometimes by the urge for justice and at other times by insurmountable circumstances.

The main objective of this study is to analyse the comparative perspective on three war-related literary texts. The First, *Ivan* by Vladimir Bogomolv, is a story of a child based in Germany who is way ahead of his age. It has rightly been described as the war ensues and the fall of Hitler is imminent, lieutenant finds evidence that Ivan is killed by the Germans. The second novel *If I Die in War Zone* is set in war-torn Vietnam. The protagonist O'Brien is forced to join the war against his wishes. Specially, this second text shows how the culture of his hamlet requires him to display courage and prove his mettle by fighting for his country. The third text is *Tamil Tigress* which depicts the life of a teenager who joins the LTTE insurgency in Sri Lanka against the discriminatory policies of the Sinhalese government. She is moved by the injustices committed by the state apparatus on the Tamil minority.

This paper attempts to engage with the political realities as they have been conceptualized by the three novelists in question. Also, a large portion of these three novels explore the nature of war, its stages and its effects on the human soul in three different parts of the world. This study uses analytical and comparative methods. The qualitative methodology of the research is carried out through texts, journals, and articles. Thus, I attempt to analyse, compare and contrast the above three war- related texts.

A case study on the effectiveness of the process, services and products provided by a popular fresh vegetable outlet in Kandy

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The vegetable and fruit subdivision is the most imperative in the Sri Lankan agricultural sector after paddy. Consumption of fresh vegetables and fruits enhances the nutritional level in the body. The aim of this study was to gain an in-depth understanding of the consumer satisfaction, types of vegetables, services provided, supply channels, problems prevailing and to recognize the opportunities for further improvement of the vegetable outlet. The qualitative research approach consisted of participant observations, interviews, document reviews, photographs, and videos were used to collect data on site with the consent of the relevant parties. Sixteen hour observations were taken at different times and on different dates. Grounded theory was used to analyze the data. Good customer satisfaction, good and quality store management with continuous supply chain, identification of problems, and attractions of different customers were identified. They belonging to different age groups, genders, cultures, ethnicities, economic levels and different regions were observed in the stall on different days. It is important that customer services adapt to meet customer expectations to ensuring customer satisfaction. For this purpose, the vegetable outlet provided the customers with a wide variety of high quality food products, efficient services and customer care at the stall.

Monitoring and awareness programs on the proper maintenance of well-organized soil conservation programs to develop marginal lands, continuous supply by the registered farmer societies without intermediates, and proper store functioning activities with the involvement of top management enable the organization to provide good-quality products and services. Limited space, improper functioning of cashiers, lack of staff members, dissatisfaction of staff with the salary and other benefits, lack of parking and other facilities and damages to products caused by customers were the problems prevailing. Suggestions for further improvements include enlargement of the stall, creating alternative parking space, and supplying required benefits to the staff members.

Knowledge on Foot and Mouth Disease among cattle and goat farmers in Nuwara Eliya district of Sri Lanka

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Foot and Mouth Disease (FMD) is a one of the earliest reported highly contagious viral diseases affecting cloven hoofed livestock and wild mammals in Sri Lanka. The economic impact of the disease is huge due to direct production losses and indirect costs associated with control measures. Extensive public education and awareness programs with appropriate knowledge translation tools are essential to minimize the economic impact of such a devastating disease. In the face of a FMD outbreak, cattle and goat farmers in the Nuwara Eliya district of Sri Lanka are at the highest risk of production losses, as the district is known to have the lowest FMD incidence and highest milk production in the country.

In the present study, we investigated the basic knowledge on FMD among 118 cattle and goat farmers in four veterinary service ranges of the Nuwara Eliya district. The study was conducted from August to November 2015 using a pretested structured questionnaire. Our results indicated that 61% of the farmers had heard about the disease and the occurrence of FMD outbreaks in Nuwara Eliya. Their knowledge about; causative agent (3%), transmission (7%), susceptible animals (15%), symptoms (9%), consequences (10%), morbidity rate (1%), mortality rate (3%), prevention and control (3%) and spreading rate of the disease (5%), were not at an acceptable level (<15%) even though 23% of the farmers had direct contact with the area veterinary surgeon. The study also revealed the daily presence of potential wild hosts/ reservoirs such as wild boar (89%), wild buffalo (16%), sambar (39%), deer (16%) in the vicinity of cattle and goats. The presence of potential wild hosts/ reservoirs poses a serious threat for controlling and eradicating FMD especially for the farmers who manage their cattle and goats semi-intensively. We envisioned our results would facilitate the selection of appropriate knowledge translation interventions and thereby close the knowledge-to-practice gaps in FMD control and eradication programs in Sri Lanka.

Youth and social media: a study on the use of social media by the new entrants in the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka

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Social media performs a pivotal role in every aspect of human life in the modern information world. The main purpose of this study is to examine the way in which social media is used by the new entrants in the faculty of Dental Sciences, University of Peradeniya, specifically the way it is used for educational purposes. All new entrants registered in the academic year 2015/2016 were selected for the study. Even though there were 85 students registered in the Dental Science library, only 75 new entrants participated in the survey. The study was carried out in February 2016, while a questionnaire that consisted of open and close ended questions was used as the main data gathering tool

The results revealed that 80% of the new entrants have been using Facebook accounts followed by Skype (37.3%), Twitter (18.7%) and Instagram (16%) as their favorite social media sites. In terms of privacy and security of their accounts, 77.3% of respondents maintained controlled accounts. Only authorized friends and relatives were permitted to view their accounts. However, 22.7% of respondents did not have an idea about the privacy and security of their accounts. Of the new entrants, 65.3% had not included their parents in the friends' list but 34.7% participants had included their parents. Nearly half of the respondents (48%) opened their accounts daily while 12% did so once a week. Fifty eight percent (58%) of new entrants rarely posted on their accounts while 24% of respondents posted once a week.

Majority of (88%) the respondents were in the view that social media helps to maintain better relationships with their friends, while 43% said that social media is one of the good platforms that helps to maintain better relationship with their family and close relatives. According to the results of the survey, 66% the respondents expressed that maintaining social media accounts is a time consuming matter while 28% expressed that social media behavior adversely affects their studies.

Entertainment was the top reason for using social media by the new entrants followed by accessing information on science, culture and sports. Many students (54.7%) had been extensively using social media for studying purposes during their Advanced Level examination period. Findings established that most of the dental Science new entrants had an adequate awareness on particular types of social media. The results confirmed that even though there are numerous types of social media available online, only few types are popular among new entrants of the Dental Science faculty of University of Peradeniya.

Relationship between anti-social behavior and stress perception of undergraduates: a case of government universities in the western province of Sri Lanka

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Anti-social behavior among students is a major national concern because students are strong enough to make noise against the government of the country. Though rates of malefaction are dropping overall, reports show that adolescent children are increasingly involved in deadlier malefaction, such as murder, rape, larceny and aggravated assault. It is reported by different kinds of media – radio, television and newspapers that bellicosity and aggression are perhaps the most prevalent forms of interaction between people in today's society. Anti-social behavior that learners exhibit in university because of stressful situations is a concern for everyone. Most learners are involved directly or indirectly in these situations. Stress perception is the feelings or noetic conceptions that an individual has about how much stress they are under at a given point in time or over a given duration. Objectives of the present research were to find out whether there is any significant relationship between different dimensions of anti-social behavior and stress perception of undergraduates in government universities in the Western Province of Sri Lanka and to find out whether there is any significant contribution of stress perception to the anti-social behavior of undergraduates in government universities in the Western Province of Sri Lanka. The sample of the present research consisted of 836 first year undergraduates studying in public universities in the Western province of Sri Lanka. Random sampling method was used to decide the sample. The normative survey method was adopted to find out the relationship between stress perception and different dimensions of anti-social behavior of undergraduates. Findings revealed that there is a positive relationship between stress perception and different dimensions of anti-social behavior such as troublesome behavior, aggressive behavior, misbehavior, threatening behavior and total anti-social behavior. There is a significant contribution of stress perception to the anti-social behavior of undergraduates and it significantly related to the dependent variable anti-social behavior of undergraduates.

Sri Lankan IT executives insight towards emotional intelligence

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Emotional intelligence (EI) is the area of cognitive competency involving traits and gregarious skills that facilitate interpersonal deportment. Present study examines the caliber of Emotional Intelligence of Sri Lankan IT Executives as it has been considered as one of the paramount aspects of Human Resource Management and of Efficacious Leadership. Although studies about emotional Intelligence have been done in Sri Lanka, this study was the first one regarding the IT Workforce. Main objective of the study is to find out the emotional intelligence of the IT Executives of Sri Lanka. The study also focuses on the need of the Employee friendly management or people friendly management and states the need for Emotional Self Awareness and Emotional Awareness among Sri Lankan IT Executives. The population for the present study was 250 Sri Lankan IT Executives who works in non IT Companies, which includes branches such as Human Resources, Accounts, Manufacture, Procurement, and Transportation. The sample size selected for the percent study was 100 Sri Lankan IT Executives. 20 Sri Lankan IT Executives from each department were selected through disproportionate random sampling method. Researchers used descriptive research design to identify the Emotional Intelligence of the Sri Lankan IT Executives in this industry. To quantify the emotional Intelligence of the respondents, Emotional Intelligence Scale developed by Hyde, Pethe and Dhar (2002) was utilized. Results revealed fifty one percent of low overall emotional intelligence and forty nine percent of high caliber of overall emotional intelligence among Sri Lankan IT executives. The Z-test between the marital status of the respondents and sundry dimension of emotional intelligence revealed that there is a paramount distinction between the marital status of the respondents with regards to sundry dimension of emotional intelligence such as trustworthiness, conscientiousness, adaptability, innovativeness, accommodation orientation. However there is no paramount difference subsists between the marital status of the respondents with regards to sundry dimension of emotional intelligence such as emotional self-vigilance, self-regulation, convivial vigilance empathy, accommodation orientation, developing others, leveraging diversity, political cognizance, relationship quotient.

Quest for reality: a preliminary study of platonic philosophy and Buddhist philosophy respectively with special reference to *the Republic* and *Dhammacakkappavattana-sutta*

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Different philosophical schools and doctrines have always attempted to investigate the fundamental issue on "Man versus Universal Reality", considering the capability and the capacity of the individual. Buddhist philosophy and the Platonic Philosophy can be considered as two such great philosophical schools that sprung from the East and the West to direct the man in the quest for Reality. Thus, this study compares Plato's conception of Reality and the discussion of spiritual growth with the Buddhist perception of Reality and spiritual growth focusing on Plato's treatise *The Republic* and the first discourse of Gautama Buddha, namely *Dhammacakkappavattana-sutta*.

Buddhist philosophy is known as a mind centric philosophy that encourages the cultivation of the mind and similarly, in Plato's *The Republic*, ψυχη (psyche) or soul is cultivated in a way to comprehend the Universal Truth that cannot be grasped though the ordinary sensory perceptions alone. Thus, whether it is through the mind or the soul, both doctrines believe that it is through the awakening of the mind's eye that human being can achieve the highest knowledge. Yet ostensibly, the prescribed processes of the cultivation of the mind's eye differ with the ultimate objectives of each of these philosophical schools. In Buddhist philosophy, the aim of spiritual growth is to eradicate suffering through ceasing the cycle of birth. But, in Platonic doctrine, spiritual growth is crucial in the upbringing of the philosoper-ruler accommodate his *Ideal State*. Therefore, the Platonic doctrine root the moral and the metaphysical theory into worldly values. Despite of these different objectives, a similar nature of expression could also be traced in these two philosophies in relation to Universal Reality. *The Form of the Good* in Platonic doctrine and *the Four Noble Truths* in Buddhist philosophy, share the common attributes such as permanency and eternity, due to their incorporeal and non-temporal existence in the metaphysical realm. Furthermore, the strenuous and extremely difficult upward movement of the cognitive states, as depicted through the analogue of *the Divided line, the Sun* and *the Cave* in Platonic doctrine reflect the virtues that are cultivated through *the Eightfold path* in Buddhist philosophy.

Environmental sustainability, food security and food labeling: a comparative analysis of nutrition labelling laws in select Asian jurisdictions

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Nutrition labeling laws could be seen to assume significance in relation to food security and environmental sustainability in the modern context. The objective of the research is to analyze the legal position regarding nutrition labeling in Sri Lanka in relation to the legal frameworks of India and Malaysia in order to identify issues which persist regarding the regulation of nutrition labelling in these jurisdictions. The research question is regarding the extent to which relevant legal instruments regarding nutrition labeling in these jurisdictions have adopted the recommendations made in international legal documents in the field of nutrition labelling. Qualitative research methodology was adopted in the research and reference was made to primary and secondary sources. Primary sources such as international standards, codes of practice and guidelines regarding nutrition labelling were considered. Secondary sources such as books and journal articles have also been referred to in the research. The research revealed that in spite of the recommendations made in international instruments such as "Guidelines on Nutrition Labelling" and "General Standard for the Labelling of and Claims for Pre-packaged Foods for Special Dietary Use", different governmental approaches have been adopted to regulate nutrition labelling in national jurisdictions such as Sri Lanka, India and Malaysia. It could be seen that even though Codex Committees have been established in these countries, diverse nutrition labelling laws have been implemented in these jurisdictions. As a result, a diversity of laws with regard to nutrition labelling could be observed in these countries which would be problematic in the efforts to ensure uniformity in this area of law. In view of the importance of nutrition labelling in realizing food security and its implications towards environmental sustainability, achieving uniformity in national nutrition labelling regulations across the region could be considered as a timely need which deserves the attention of lawmakers in the region.

Interactive multimedia drama to popularize the tea industry among school children in tea growing areas of Sri Lanka

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The Sri Lankan tea industry, which produces arguably the best black tea ("Ceylon Tea"), plays a major role in the economy of Sri Lanka and provides a reasonable family income. However, the industry is facing serious problems due to lack of participation by the younger generation. The rural young children of the tea smallholders and the plantations workers are the most important group that needs to be attracted to tea cultivation and other related occupations. Hence, special motivational programmes need to be developed to attract them to the tea industry, which has a high potential for making profits.

Entertainment-education is a more effective way to influence attitudes and behavior than traditional persuasive messages. Interactive drama methods are helpful in achieving educational goals by creating a hospitable space for conversational learning. Therefore the objective of this study was to develop an interactive multimedia drama programme to create awareness, enthusiasm and positive attitudes among senior school children in the tea growing areas towards the tea industry.

A preliminary needs identification survey was conducted with 70 randomly selected high school children from nine schools in Matara district. It was found that they have negative attitudes towards the tea industry and poor knowledge of its economic importance, health effects and mechanization. Based on these findings, an Interactive Multimedia Drama programme was developed incorporating Education-Entertainment, Personal-Dramatic, and Theoretical-Practical message treatments. Selected features of street drama, interactive drama and stage drama and multimedia were blended to present the key messages

A before and after study was conducted in the preliminary evaluation of the programme using 60 school children from a rural mixed school in Kandy district. Results showed that there was significant knowledge gain ($P<0.05$) on health effects, economic importance and machinery use in tea. The schoolteachers and the extension staff also confirmed that the interactive multimedia drama was entertaining and effective. This programme is proposed to be improves using further evaluations and to be used in the '150 years of Ceylon Tea' campaign in the year 2017, to motivate the young rural and plantation youth to engage in the tea industry.

PAPER NOT PRESENTED

"To be or not to be: that is *not* the question": a study of suicide in university discourse

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Suicide is generally conceived as a way out, a decision taken in desperation to escape the agony or misery caused by some heart break, betrayal, or disillusionment – some sort of bleakness that overwhelms life. Certainly, the discourse on suicide is dominated by the inkling that people commit suicide since life is not worth living or, perhaps due to their inability to face challenges in life. However, this view overlooks resistance articulated through suicide. In such a background this paper underscores the need to read suicide as a form of resistance: disavowal of forced subjectification, and an attempt to interrogate technologies of power which ostracize and oppress individuals who refuse to be reduced to nonentities.

This study focuses on two cases of suicide as symbolic gestures which challenge structures of power and strategic modes of inhibition operating in Sri Lankan State Universities. This investigation is theoretically supported by Michele Foucault's analysis of knowledge, discipline and power, and Judith Butler's theoretical approach to identity politics, death and mourning. Moreover, it draws from newspaper articles, individual and focus group interviews and information gathered through informal conversations. The University community, in terms of its socio-cultural and economic representation and entrenched hierarchies represents the broader Sri Lankan society. And my positionality as a university teacher and a former student who was subjected to different forms of violence propelled me to revisit and reread the contextual significance of two cases of suicide, as reported from the University of Peradeniya and University of Sabaragamuwa in 2014 and 2015 respectively.

This study concludes that the cited suicide cases can be read as formidable decisions made by individuals as forthright attempts to resist being swallowed up by a violent, brutalized social group which attempts to (re)socialize them with a vengeance. In fact, it is a premeditated attempt to make their presence felt, to articulate their agency and to disrupt the taken for granted "order" in the University community.

Cicero on ageing gracefully: a modern reading of Cicero's *De Senectute*

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The phenomenon of ageing naturally affects the individual and the society alike. For a person, the process of ageing could indeed be daunting, with the complications in physical and mental health, financial difficulties, sense of abandonment, helplessness and the fear of death that it brings. Similarly, the ageing population poses numerous socio-economic problems, especially if they are not properly integrated in to the society. This resulted in an extremely negative outlook on old age. It is in such context that the concept of 'ageing gracefully' emerges in the field of gerontology, as a mechanism to help one to come to terms with old age as well as to assist incorporating the elderly into the society in a way that would benefit both the individual and the society.

Though the discourse on old age appears to be a recent one, there are a number of references on the topic found in works of classical authors. One such interesting treatise is Cicero's *De Senectute* (*On Old Age*). Thus, this study looks into Cicero's *De Senectute* in an attempt to delineate ideals pertaining to graceful ageing reflected in it. In the process, works of modern critics and scholars are brought in for the purpose of comparison and analysis.

Upon close scrutiny, it is apparent that Cicero's portrayal of old age is idealistic and romanticised. However, Cicero induces the reader to look at old age from a fresh perspective. At the beginning Cicero does identify, and thereby comes to accept, a number of adversities associated with old age. Next Cicero prompts the reader to think beyond these and focus on the 'benefits' of old age resulting in an attitude change. As the final stage, Cicero encourages one to use these 'benefits' in a way that would serve the society; leading to the efficient incorporation of the old into the society. Together this process helps the individual to age gracefully and by extension assists the society to deal with, at least up to an extent, the numerous problems associated with old age. Accordingly, Cicero's *De Senectute* clearly manifests a number of fundamentals concerning the idea of graceful ageing.

Psycho-social analysis of parental influence at casual work and its impact on late teenagers' volition

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The term volition is understood and interpreted differently based on the context it is being used. In simple terms, volition is the autonomous will power in decision making. The definition itself suggests its crucial importance and its influence on one's personality. Understanding the factors affecting volition is important as the teenagers in today's society immensely encounter problems related to decision making and personality related issues. Casual work refers to household work that is supposed to be performed by respective individuals; work such as washing clothes, making the bed, cleaning and arranging one's own room, etc. The initial observations and discussions which were conducted prior to the research showed that this casual work is given less consideration by the parents and they influence their children's casual work a lot making their children depend on them irrespective of the gender. This kind of casual work has not received sufficient academic attention. Hence this research was conducted to find out if there is a significant relationship between volition and parental influence on casual work of 18 years old teenagers. The research followed the qualitative method with a sample of 35 subjects. In depth interviews were conducted to measure volition and performance related to casual work. Each section was assessed by independent examiners using a coding framework. The results demonstrated a significant relationship between volition and parental influence at casual work revealing that the individuals who are more likely to perform their personal household work by themselves are more likely to have high volition and tendency towards rational decision making whereas some individuals who depend on their parents in performing personal household work showed high volition with a tendency towards irrational decision making. The results emphasize the need for raising awareness in the parents and responsible figures regarding the importance of letting their children perform casual work by themselves as it strongly affect one's personality.

National memory and digital platforms: imagining post-war Sri Lanka on the facebook page Humans of northern Sri Lanka

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The research explores the impact of the Facebook page *Humans of Northern Sri Lanka* on challenging the national memory of post-war Sri Lanka. The study is conducted based on theoretical frameworks which draw from concepts primarily related to nation, nationalism and digital media. The study employs a qualitative methodological approach in gathering data mainly through content analysis and archival research while drawing additional information from semi- structured interviews. The research also explores the possibility of challenging national memory through the structure of digital platforms. It thereby examines the possibility of reconfiguring concepts of space and time of the imagined nation and nation-state through digital platforms. The research engages with the potential for digital activism in utilising Facebook as an alternative platform and also delves into areas related to narrating memory from multiple positions, exclusion of memories from the national narrative, pedagogic and performative memories, mobility of memory and inclusion of individual, collective and cultural memories on digital platforms.

Effectiveness of social capital for empowerment of women: a study on *Neethra Samadhi* women's foundation

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Social capital means the relationship between two or few individuals to share common values or norms. In other words, it is the cooperation between individuals based on shared norms to be further strengthened as a group. By being a group it is possible to efficiently achieve economic, social, political and cultural needs. The use of social capital to achieve those goals in the developed countries is substantially higher than in the developing countries. However, from the recent past, the creation of cooperative organizations based on trust is very much popular among women in Sri Lanka. Though there is enough literature from the Sri Lankan context on gender and politics, women's political participation and domestic violence against women, there is no adequate literature on how social capital has proceeded to empower women in terms of economic, social and political development. Therefore this study raises the question as to what extent social capital has affected the empowerment of women in Sri Lanka, by focusing on *Neethra Samadhi* Women's Foundation (NSWF) as the case study. The NSWF provides membership for all women in the age group of 18 to 55. Its membership is totally free. Women have gathered to understand the economic and social backgrounds of each other and to help each other by sharing their economic and financial capabilities. The study was conducted basically focusing on the NSWF which carries the membership of women in the *Kesbewa* Divisional Secretariat area. Both primary and secondary data were used in this research. Content analysis, focus group discussions, open-ended questionnaire survey and few case studies were used as the means of data collecting. The sample size for the questionnaire survey was 40. Following the purposive sampling technique, out of the total 73 *Grama Niladhari* Divisions, four *Grama Niladhari* Divisions, i.e. *Boralesgamuwa* East A, *Diulpitiya* East, *Pepiliyana* West and *Pepiliyana* East B, were selected for the questionnaire survey.The data which could not be collected from the questionnaire survey, were gathered through focused group discussions and case studies. The data were analyzed using the descriptive analysis method. Due to lack of socialization, more than 80% of women have become poorer. Though some of the young women have developed their knowledge and skills by studying professional courses such as pharmaceutical, computer literacy, dress making, shoe making and handicraft, most employers hesitate to offer job opportunities to them due to their social status and poor family backgrounds. By becoming members of a women's foundation, they interact and help each other by playing the advisory role in settling family matters, finding job opportunities, providing financial and material support for self-employment; for instance when some women have skills to be a tailor or a dressmaker but do not have basic necessities such as a work-place, tools, machines, publicity, clients and selling facilities. After being a member of the NSWF, the women have increased their monthly income levels to 15000 rupees from 4000 to 5000 rupees due to the increase in income generating opportunities. The foundation has only the collective participation to bargain and to receive the services from the public and private sector institutions.

Different types of usage of the suffix 'hu' (හු) as a noun case in Sinhala writing

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Suffixes of noun case are special suffixes that are followed by a noun and they can imply singular or plural meanings. After combining these suffixes to the nominal root, it converts to a noun and deserves to be used in a sentence. The suffix 'hu' has been used in different cases since the Anuradhapura era. The main purpose of this research is to find out how the suffix '*hu'* has been used in different cases, its origin and evolution and the way it becomes a plural nominative suffix prior to the art of Sinhala witting. This research is based on literary sources and inscriptions. The suffix 'hu' is hardly used in the cases, except in the nominative case, at present. According to the research, *hu* has been used in different cases including the nominative from the Anuradhapura era to 1936.

Case	Examples	Period
Nominative case	*Tavasara<u>hu</u> dam desat (Subjective)*	Dambadeniya
	Kisivak<u>hu</u> no<u>d</u>æka (objective)	Kurunagala
Accusative case	*Vastu<u>hu</u> shudda vana bævin*	Polonnaruva
Instrumental case	*Maharaj<u>hu</u> sat læbu*	Anuradhapura
Dative case	*Veleda<u>hu</u>ta badu de*	Dambadeniya
Ablative case	*Piyaraja<u>hu</u> atin*	Kurunagala
Genitive case	*Maharj<u>hu</u> sohovur*	Anuradhapura

Considering the examples found in Sinhala literature and inscription, '*hu'* suffix has been used with different faces which can be categorized as follows:

As suffix of case

Vastu<u>hu</u> shudda vana bævin

Here, *hu* is isolated and it indicates the meaning of accusative case.

As a helping suffix of case

Rathnakarayakhuge Sri vibuthi abibhavamin

In this sentence, the *hu* suffix has been used as a helping suffix to the suffix '*ge'*

As a helping suffix with proposition

Sunanda nam ajeevakayakhu visin

'*hu'* is used with a preposition in cases like instrumental, ablative and locative.

The suffix 'hu' originated in Anuradhapura era and was frequently used in different cases in inscription. So, it has been used in Sinhala literature up to 1936 in some ways, but after the *Piyasamara,* 'hu' is limited to plural suffix in nominative case. Specially, it can be seen in Gamperaliya written by Martin wickracmasinghe in 1944. The influence of western literature and the use of colloquial language for writing mainly caused the disappearance of it.

Finally, as a conclusion, it can be mentioned that the suffix 'hu,' which starts in the Anuradhapura era has evolved up to date. Although it has been functioned in many cases with different faces from the Anuradhapura era to 1936, at present it is limited to nominative case.

A medical-sociological study on accessibility of health care services for the war-disabled in Kilinochchi District

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The prolonged civil war in Sri Lanka caused serious public health and social issues. This medical-sociological community based study was conducted in all four Divisional Secretariat Divisions in the Kilinochchi District. The prime objective of this study was to assess the accessibility of health care services for the war-disabled in the Kilinochchi District. This research study employed the mixed method. Based on the stratified random sampling method, 316 people with war-related disabilities were selected for the questionnaire survey. Qualitative data were also collected through the case study method, the direct observation method, key informant interviews, focus group discussions, and the participatory research methods.

There were 13 848 people with disabilities (PWDs) and among them 5260 were war-disabled from the Northern Province of Sri Lanka. The prevalence of war related disabilities was high in the Mullaitivu District (65.4%) and Kilinochchi District (60%). The study revealed that 93.4 per cent of the PWDs in the study area stated that they were not able to access adequate health-care services during the last phase of the war. The overall findings of this research revealed that the war-disabled in the Kilinochchi District faced enormous difficulties in accessing health care services. Survey results revealed that war was the primary cause for amputation which constituted 76 percent of the PWDs. Spinal cord injury was the second major form of the war-related disability among the study sample. Results revealed that 99.7 per cent of PWDs sought medical assistance from the government health care institutions. Nearly 46.5 per cent of the PWDs are dissatisfied with the available health-care services while 3.2 per cent of PWDs are totally dissatisfied with the available health-care services. Adequate health facilities were not available for the PWDs at government's hospitals and clinics or private clinics in the Kilinochchi District. The study also indicated that lack of transport, distance from the health care institution, the poor condition of accessible facilities in the hospitals and other health care institutions, lack of medical experts, poverty and poor coordination among the health care service providing institutions were key barriers for accessing health care services for PWDs in the Kilinochchi District. Although more than two thousand PWDs lived in the Kilinochchi District, no dedicated health services such as mobile clinics and community based medical rehabilitation services were available to PWDs in the government hospitals and clinics. In view of the limitation of health care professionals or consultant services in the Kilinochchi District, PWDs sought medical assistance from the Teaching Hospital, Jaffna or District General Hospital, Vavuniya. The government health services were not geared with inclusive health care services such as medical rehabilitation services, disability care and accessibility facilities for the PWDs at health care institutions in the war affected villages in the Kilinochchi District. The Ministry of health with the Government of Sri Lanka should develop and improve the accessibility of health care services such as accessible facilities in the hospital setting and the community based medical rehabilitation services for PWDs to promote their well-being and quality of life.

Reading habits of undergraduates at the South Eastern University of Sri Lanka

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This study is an attempt to understand the reading habits of undergraduates at the Department of Islamic Studies at the South Eastern University of Sri Lanka. The study employed a questionnaire survey under six categories of measures. 40% of the sample is drawn from the total student body of 508. Accordingly, 203 printed, structured questionnaires were administered. Results indicated that 76% of the respondents' reading habits are nurtured by their parents or teachers. Significant differences exist between academic and recreational reading. 78% of the first year, 67% of the second year, 59% of the third year and 33 % of final year students had engaged in leisure reading during the previous month. The students' three major sources for reading material are libraries, internet and friends. Romance, Fantasy and Classics are the top most popular genres of reading. Results (69%) indicated that they engage in listening to music and eating while reading both academic and recreational materials. 82% of the respondents prefer online electronic format over printed format. However, reading online material is limited to online news and gossip web sites. The majority (83%) spends more than 2 hours to read online news and gossip web sites, while only one-third of the students (34%) spend less than 1 hour daily in reading academic material. The study concludes that recreational reading is popular over academic reading and considerable time is spent over reading information on the web. Academic reading is not regularly undertaken. Parents and teachers have significant authority over nurturing reading habits. More time allocation for librarians to interact with students to boost reading habits and teaching students to balance the utilization of both new and traditional methods of extracting knowledge to be lifelong readers and learners is suggested. Limitations of the study are attributed to the inadequate number of variables studied and the inclusion of only one faculty. This research could contribute towards carrying out future research in similar areas with a wider scope and a broader population. Findings are significant for authorities of the university in making future decisions on undergraduate students as well as on library allocations.

Monologue to dialogue: the changing role of female ex-combatants and faceing encounters

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The patriarchal, political and socio-cultural roots of the Sri Lankan society has solidified the perception of women as a secondary group who represents feminine values such as caring, nurturing and feeding families in the domestic sphere. During and after the civil war in Sri Lanka, this traditional feminine role has been expanded into two new areas first as a decision maker in female headed households and second as a freedom fighter in the Tamil community. The leadership of the Liberation Tigers of Tamil Eelam (LTTE) has redefined the phenomenon of freedom fighter by challenging the traditional Tamil concepts of widowhood, dowry for marriages, and the male-female dichotomy in labour.

The objective of this paper is to explore and attempt to reread the inside story of female ex-combatants after the civil war. The universal knowledge about female ex-combatants has been focused on reading the transformation of combatant to non-combatant lives and analysis of the challenges in their everyday lives. This paper is an extension of the existing knowledge, but has deviated in order to understand the dual role of female ex-combatants. The research question is how female ex-combatants interpret their role during and after the civil war. The data for the research were collected through qualitative strategies and narrative analysis was applied to interpret them. The data were collected from 20 female ex-combatants living in Udayarkattu village in Mullativu district.

According to the female ex-combatants stories, the civil war was a way to emancipate women's souls from the boundaries in the traditional Tamil community. These women have identified themselves as agents to change the traditional system and liberate the Tamil community from suppression and marginalisation. According to their narratives, the end of the civil war has made their lives unsecure, subordinate and isolated. They have gradually adapted to the new situation and adopted resilient strategies rather than resisting to the new social system.

The role of female ex-combatants after the civil war is debatable. The female ex-combatants had to play a duel and contradictory role during wartime. Female ex-combatants had a radical role in changing and questioning the system which was against women's liberty. Today, they have become a subordinate group to the men's leadership and become agents of continuing Tamil cultural values.

PAPER NOT PRESENTED

A survey on internet use among university undergraduates

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The internet is considered the most vital technological development in the 20th century due to its impact on teaching, learning and research. In tandem with this technological boost, the government of Sri Lanka has invested significantly to increase the usage of ICT through many programmes. University authorities in Sri Lanka are also making tremendous efforts to improve ICT infrastructure in their institutions. Under this setting, the study aims to identify the level of penetration of internet usage among undergraduate students, in the case of South Eastern University of Sri Lanka. A questionnaire survey among randomly selected 15% (n= 289) students of the Faculty of Islamic Studies and Arabic Language (FIA) and the Faculty of Arts and Culture (FAC) was employed in this case study. The results demonstrated that most of the students (92%) use the internet consistently and the great majority of them (FAC-75% and FIA-79%) have a history of using the internet for more than 4 years. Respondents of FIA (69%) and FAC (61%) have learned to use internet tools by themselves. Similarly 65% of the students of FAC and 72% of FIA search the internet from their own tablet computers or smart phones. However, in both Faculties accessing the internet for academic purposes remained low. Google is the most popular search engine for 79% of the students followed by Yahoo (43%). Moreover, 82% use Yahoo email service and 71% mentioned Wikipedia as the major source of academic information. In both faculties 76% use the internet on a daily basis. These numbers indicate that policies and infrastructure should be immediately introduced, implemented and established University wide by providing more access points and promoting services among the undergraduates. In summary, the research indicates that this Net-savvy young group under study appears to be immersed in new technology that traditional education is not endowed with. Thus, it is recommended to introduce an information literacy component in each degree programme to train students to effectively use the internet and related ERs. However, a widespread survey is of a dire necessity to understand the level of internet penetration in the lives of undergraduates in tertiary education.

Managing solid waste in the University of Peradeniya: successes and failures of strategies

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Solid Waste Management (SWM) refers to the supervising and handling of SW from its generation to disposal. While many developed countries manage their solid waste using several strategies, most developing countries still suffer from this problem since there is no proper system to manage it. In Sri Lanka, due to the lack of systematic mechanisms for managing solid waste, it has become one of the serious national problems of the country. Today the situation has become worse with the problem spreading beyond the main urban areas of the country to semi-urban areas and places where people are concentrated such as educational institutions and health facilities. It is a threat to both physical and social environment, leading to many health and social problem as well. This paper examines the problem of solid waste in the University of Peradeniya. There are two objectives to this study: to examine the strategies that the university is implementing to manage its solid waste problem and to evaluate successes and failures of such strategies from the point of view of the university community and relevant implementing bodies. The study covered a sample of 50 households (University quarters) selected through simple random sampling method. Further, data was collected from students and wardens of two student's hostels (male and female) and employers of one administrative block. The study primarily used qualitative data collection techniques such as interviews, discussion and researcher observation. In addition, to support the primary data, secondary data was collected from existing reports using desk survey. The study revealed that though the majority of the university community is generally happy about the new waste management system, cooperation extended by the members of the university community is poor and is the main reason for the shortcomings experienced. Separation of waste at the generating points is not satisfactory in all the areas. Further, the system that is being implemented is not well coordinated. Less awareness of the solid waste problem among the university community and the lack of infrastructure facilities are also reasons for such failures. Waste collection is regular and the community is generally satisfied with the collection timetable.

Strategies adopted by a municipal council to obtain the community participation for solid waste management activities: a sociological study with special reference to Kandy municipal council in the central province of Sri Lanka

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Solid waste has become one of the most serious problems around the world mainly due to rapid urbanization. In Sri Lanka, it is a growing problem in urban areas as it creates most severe environmental, health and social problems. With huge amounts of waste generation every year, Local Authorities in Sri Lanka are facing difficulties in its' systematic management. Solid waste management is one of the activities where community participation is key to success.

The study was carried out in order to achieve two primary objectives: to examine the strategies used by the Municipal Council to get community participation for solid waste management activities and to examine nature of community participation for the strategies. The study was carried out using qualitative data collection methods in Kandy Municipal Council in the Central Province, Sri Lanka.

As the study revealed, several strategies have been taken by Municipal Council to get the participation of community for solid waste management activities. Conduction of awareness programs, popularizing composting, introduction of community friendly waste storing methods and events, formation of environment committee, introduce labour benefits, service of community health assistants and environment police are the main strategies used by Municipal Council. Community participation is higher to forceful strategies than voluntary strategies due to its nature of obligatory. Therefore the study suggests the important of improving the environmental education among community from kindergarten level in order to increase the voluntary participation.

Preliminary Geo-archaeological study of *Lunuhunugala* rock shelter at Aranayaka - Sri Lanka

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Preliminary Geo-archaeological studies in and around *Lunuhunugala* rock shelter at Aranayaka, Kegalle district, Sri Lanka, imply a possible habitation site. Field investigations were carried out for the understanding of the importance of speleological, prehistoric and palaeo-environmental values of this site. The area falls into the wet zone of Sri Lanka, located in the Western valley of the Maha Oya stream. It is at an elevation of 723m AMSL on the foothills of *Getaberikanda* Mountain (7°09'06" N, 80°26'40" E). Speleological studies suggest that the formation of the rock shelter is strongly influenced by the mineralogy and structure of the rock. The rock shelter is formed in a geologically weak zone, evident from the intruded quartz veins which cross-cut the foliation of the rock along weak planes. Exfoliation caused by differential expansion among curved rock layers has caused them to weaken and eventually peel off. This is mainly due to the recurring effect of heating during day time and cooling at night. Also, differential weathering of rock layers with different chemistry has involved in forming cavity like features on the rock face.

Many rock shelters in the wet-zone highlands of Sri Lanka have yielded some of the earliest evidence for the existence of *Homo sapiens* in South Asia during Pleistocene and Holocene. *Lunuhunugala* preserves evidence for the presence of some tool industry and food culture of prehistoric man in the wet zone highlands, most probably over the same period of time. A material culture, marked by possible stone tools made by quartz fragments together with possible faunal and floral remains, provide evidence for suitable habitats in this site. The environment of *Lunuhunugala* may have retained as a forest, supplementing the inhabitants' food culture and technology, serving as a human habitation site. The prehistoric inhabitants foraged for a broad spectrum of plant and mainly arboreal animal resources derived from a landscape that retained an equatorial rainforest cover through this period. Finally, the *Lunuhunugala* rock shelter demonstrates the Late Pleistocene pathway, the prehistoric societies, and their dynamic ecological context also contributing to a number of debates on the human ecology of prehistoric foragers and the cultural diversity in the wet zone of the Island.

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Auto-regressive distributed lag model on forecasting tourist arrivals from Asian region to Sri Lanka

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When one analyzes the tourism industry in Sri Lanka, it clearly shows the historical development of tourist arrivals every year. The Asian region is the highest tourist producer to the tourism market in Sri Lanka. With the increase in tourist arrivals from the Asian region, the government needs a correct method of forecasting tourist arrivals to cope with uncertain situations and resource management. Therefore, this study focused on identifying a suitable model to test the ADLM on forecasting tourist arrivals to Sri Lanka from the Asian region.

Monthly tourist arrival data from 2009 to 2014 were obtained from statistical reports of 2009 and 2014 from the Sri Lanka Tourism Development Authority (SLTDA). Auto-regressive Distributed Lag Model (ADLM) was tested on forecasting tourist arrivals. One way Analysis of Variance (ANOVA) technique was used for overall model testing and t- test was used for individual parameter testing.

The residual plots, Anderson –Darling and Durbin- Watson tests for residuals were used as a model validation criterion. Stationary of the series was tested by Augmented Dickey-Fuller Test (ADFT) and Auto Correlation Function (ACF). The forecasting ability of the models was assessed by considering both relative and absolute measurements of errors.

ADFT and ACF confirmed the non-stationary of the series. The results revealed that lag 1 is significant. The P value of Anderson-Darling test was (P= 0.534) and the Durbin-Watson statistic was 1.93. It confirmed the normality and independence of residuals. Adjusted R^2 of the model is 76.8%. The Mean Absolute Percentage Error (MAPE) values of fitting and verification of model with lag 1 were 1.36 % and 1.03% respectively; Mean Absolute Deviation (MAD) was 0.133 and 0.110 of fitting and verification; Mean Square Error (MSE) was 0.028 and 0.012. It was concluded that the ADLM with lag one is suitable for forecasting tourist arrivals from Asian region to Sri Lanka. It is recommended to try other time series techniques; decomposition techniques, Circular Model and Seasonal Auto Regressive Integrated Moving Average (SARIMA) models to capture the seasonal behavior of the series.

Effect of accounting services outsourcing on SMEs performance in Nigeria: evidence from garment, apparel and footwear enterprises

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This study analyses the direct effect of Accounting Services Outsourcing (ASO) on the performance of Small and Medium Enterprises (SMEs) in Nigeria with evidences taken from Garment, Apparel and Footwear industries. The study design is an exploratory quantitative approach employing secondary data to obtain objective information on Key Performance Indicators (KPI) peculiar to Nigerian SMEs. This is a three year time series analysis from 2010 to 2012. Three Hundred and Sixty (360) SMEs were sampled and data was obtained from the data base of Small and Medium Enterprises Development Agency of Nigeria (SMEDAN). The study revealed that the key driver of this productivity growth was the product of Other Woven Fabric (OWF), which dominates the activity with output valued at NGN 683 million in 2010 and an output value improved by NGN 283 million in 2011, to reach NGN 966 million of the manufacturing total. In 2012 OWF production increased further, attaining NGN 1,369 million of the total output of the manufacturing sector in that year. Leather Shoes (LS) followed after OWF, though with a fluctuating growth. LS contributed NGN 36.03 million in 2010, impressively NGN 81.04 million in 2011 but declined to NGN 74.05 million in 2012. The results of the regression analysis reveal that there is positive correlation between all the performance variables and the outsourcing intensity. Furthermore, it also uncovers a positive association between ASO and SMEs performance. This is supported by regression coefficient of $R^2 = 0.657$, adjusted $R^2 = 0.649$. Hence, the hypothesis is being supported to establish a positive link between ASO and SME performance. Thus, the study recommends that outsourcing strategy be embraced by SMEs to take advantage of improved performance to ensure continuity, expansion and strategic positioning in the competitive business environment.

Economics and Management

Impact of intervention on socio-economic status of village chicken rearing farmers: a case in Karuwalagaswewa and Thirappane veterinary divisions

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Village chickens contribute to 15% of the national egg production. Although the village chickens arepoor producers of eggs, farmers tend to rear them because of the favorable characteristics exhibited by village chicken. This study was conducted to evaluate the change in the socio economic status of village chicken farmers in Karuwalagaswewa and Thirappane veterinary ranges due to intervention done by a recent project. A sample of eighty seven farmers representing four villages was interviewed by a detailed survey. The improvement of the village chicken farmers in terms of livelihood and farming conditions after the intervention was determined using Wilcoxon sign rank test and simple mean percentages. A cost-benefit analysis was conducted using Net Present Value and Benefit Cost Ratio to evaluate the worthiness of establishing mini hatcheries in both sites. The results of the cost-benefit analysis showed that the establishment of mini hatcheries was a worthy intervention. The awareness about diseases, poultry housing management, knowledge level of farmers on poultry farming, connection with other farmers, communication ability and knowledge on marketing were significantly high (P<0.05) among the farmers who participated in the project as a result of the training programs conducted by the project. However, obtaining veterinary services and the practice of using vaccinations to prevent diseases has not significantly improved (P>0.05) by the interventions done through the project. Nevertheless, the ranking index indicated that the most affecting constraint revealed by village chicken farmers was lapses in obtaining veterinary services. Thus, the findings of the present study indicated that the project interventions could make an impact on direct drivers of socio-economic development of the farming community whereas indirect drivers such as linking with service providers and allied offices was least influenced. Accordingly, the overall impact of the project intervention on socio economic development of village chicken farmers was high. However, the impact could be further enhanced through an integrated approach in addressing indirect drivers influencing socio-economic status of farmers.

Solving printing press job sequencing problem with a new heuristic algorithm

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Job sequencing problems can be found widely in the industrial sector. Applications of operation research are used to find optimal solutions to these problems. Since the number of jobs and machines is large in practical situations, developing a job sequence in industry is difficult. Since job sequencing is a dynamic process, a job pool depends on time. So it has to be updated every day. Earliest Due Date (EDD) with the machine completion time has to be considered to minimize the tardiness.

In this article, scheduling is considered relating to the printing industry. In general, customers' requirements should be satisfied while maximizing the overall profit of the printing press.

Here the objective is to develop a general heuristic algorithm to obtain an optimum job sequence of *n* jobs on *m* machines based on *EDD* and greedy approach by minimizing the total idle time of the machines.

Generally, machines can run up to that specific level, and their maximum expected production can be accomplished. The proposed algorithm achieves the maximum machine capacity by selecting the job, which has the minimum machine idle time. So the production can be maximized and the machine failures can be minimized. Hence, the optimum sequence obtained by this proposed algorithm helps to maximize the profit of the printing press indirectly.

The operation of the proposed algorithm was illustrated by a numerical example with the use of Microsoft Excel. The input parameters are the order placing date, due date of the jobs and processing time for every job in the supplied machines.

The proposed algorithm is comparable to the developed Branch and Bound algorithm which minimizes the tardiness and total completion time separately. This heuristic algorithm combines both objectives together and along with the addition of dynamic approach.

The interruption of the currently processing jobs can be minimized by handling the process according to optimum job sequence. However, the current due date of any job which cannot be completed on or before the due date can be postponed if the customer agrees to it, and can be included in the process.

Pricing to market and exchange rate pass through in the Sri Lanka tea export markets

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This paper studies the pricing to market strategy across Sri Lankan tea export destinations by examining exchange-rate pass-through into export prices of tea packets, tea bags, tea in bulk, and other forms of tea for ten destination countries from 2003 to 2014. For this purpose, quantity and total value of tea exports were collected from the Export Development Board. Exchange rates in direct quotations (Sri Lankan rupees per a foreign currency) are obtained from Annual Reports published by Central Bank of Sri Lanka. This study employs a linear mixed model in panel data to appropriately capture pricing behaviour of Sri Lankan tea exports to the selected destination markets. The significant negative coefficient of exchange rate indicates that incomplete exchange-rate pass-through occurs for Sri Lankan tea exports. Export prices of tea packets and other forms of tea are adjusted upward by 0.7% and 1.5% for a 10% appreciation of the Sri Lankan rupees relative to the foreign currencies respectively. In other words, Export prices of tea packets and other forms of tea are adjusted downward by 0.7% and 1.5% for a 10% depreciation of the Sri Lankan rupees relative to the foreign currencies respectively. Export prices of tea bags are adjusted upward by 1.7% for a 10% appreciation the Sri Lankan rupees, but this coefficient is significant at 10% level. Coefficient of exchange rate for the tea in bulk is insignificant that indicates that export price of tea in bulk is not adjusted for the appreciation or depreciation of Sri Lankan rupees relative to the foreign currencies. These results indicate that tea exporters persistently exercise non-competitive pricing. This study suggests that tea exporters have been making a considerable effort to expand their international markets and its long run pricing to market strategy appears to work through incomplete exchange-rate pass-through. Expanding market share of tea exports by implementing incomplete exchange-rate pass-through has been a strategically viable plan.

Determinants of Internet Financial Reporting (IFR): evidence from top twenty listed companies in Colombo Stock Exchange (CSE), Sri Lanka

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Disseminating financial information via internet is one strategy used by decision makers to capture a wider audience and to disclose more information than what is possible from traditional paper – based reporting. Therefore the present study focused to establish the level and the determinants of IFR done by companies listed in CSE.

Consequently top twenty listed companies ranked by Standard and Poor (S&P) Sri Lanka Index in 2015 were surveyed since they assist both local and international investors to gauge the performance of the equity market in Sri Lanka. The level of IFR was evaluated on the basis of the IFR index composed of fifty three Disclosure Content (DC) and twenty five Presentation Format (PF) related elements by weighting them to 60% and 40% respectively and the relevant information were gathered by directly visiting the websites of the companies. The level of IFR and the impact of eight factors on IFR index were analyzed through a Multiple Regression Analysis. Accordingly Board Size, Role Duality and Ownership Concentration are considered as corporate governance variables while Company Size, Auditor Type, Profitability, Leverage and Liquidity are considered as firm specific variables.

(The study discloses that the level of IFR done by listed companies is above average. Further it provides evidence that IFR is significantly and positively influenced by the firm specific variables namely Company Size, Profitability, Leverage and Liquidity while the influence of corporate governance and ownership concentration is significant and negative. These findings reveal that large size companies in terms of total assets, companies with higher Return on Capital Employed, higher debt to equity ratios, higher current ratios and low percentage of shares held by the directors are more likely to engage in IFR. However findings do not show a significant relationship between IFR and rest of the corporate governance variables namely Board Size and Role Duality. Auditor Type becomes a constant variable in this study and this circumstance reveals that all the companies in the sample are audited by the audit firms affiliated by Big-4 audit firms and that may be the possible reason that the level of IFR is above average since the Big-4 audit firms highly motivate their clients to engage in more disclosure. Therefore the results portray that the companies with superior features do more internet reporting since internet is an effective media today to do more promotion at lower cost.

Findings of the study are essential as they assist in informing regulators about the characteristics of listed companies that are and are not satisfying domestic and international investors' demand on online information. Further it facilitates CSE whose main objective is to monitor the fair and orderly functions of the markets and protecting the rights of the investors.

Factors influencing success of fashion design entrepreneurship in Sri Lanka

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Successful fashion entrepreneurs play a significant role in driving the local fashion industry forward. As entrepreneurs are important actors of the fashion business, it is essential to provide systematic guidance in order to achieve business success through incubation and support programmes. Support initiatives depend on knowledge of diverse factors that would influence the fashion business. Fashion entrepreneurship has not being subject to systematic research in Sri Lanka. Therefore, this research focuses on identification and discussion of factors influencing fashion entrepreneurship in Sri Lanka.

The research started with a review of literature, which divides the influential factors into four main categories: (1) Business Characteristics; (2) Personality, Attitudes and Behavioural factors; (3) Environmental factors; and (4) Strategic factors. The information about fashion businesses were solicited through available databases of main fashion events such as Colombo Fashion Week and also through social media. A random sample of 180 successfully established and emerging fashion entrepreneurs participated in the survey, out of which 85 participants responded. The importance of each factor was analysed according to four main categories based on the questionnaire responses provided by fashion design entrepreneurs who have launched their own fashion enterprises in Colombo and suburbs. Statistical techniques available on Microsoft Excel such as tabulation, graphing, mean, and median, and standard deviation were used for the analysis.

The analysis highlights that personality, attitudes and behavioural factors are the most influential factors of fashion design entrepreneurship. The findings revealed that fashion entrepreneurs' personal identity, as expressed through their personality and attitudes, influence entrepreneurial behaviour in fashion designers. The findings also reveal that personal identity is constructed through interaction of social and cultural factors prevailing in Sri Lanka. It facilitates fashion entrepreneurs to recognise their personal identity construction that influence their business decisions so that favourable identity constructions are identified and nourished while non-favourable constructions are redefined. The findings reveal that the external factors can be managed through recognising, developing and redefining their personality, attitudes and behaviour in the process of developing successful fashion enterprises.

Economics and Management

PAPER NOT PRESENTED

Impact of mandatory offer announcements on stock returns in Colombo Stock Exchange (CSE)

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This study attempts to examine the impact of mandatory offer announcements on stock return in the Colombo Stock Exchange and highlights the mandatory offers and its grounds in the legal system in Sri Lanka. Although there are few of studies on mandatory offers in stock exchanges, it is hard to find the studies on impact of mandatory offers on stock return in Sri Lankan context. The primary aim of this study is to study the impact of mandatory offers on stock return in Colombo stock Exchange using the sample of mandatory offers during year 2010 to 2014. This research used secondary data for the purpose of analysis and employed event study methodology for the purse of the analysis. More specifically, it employs the market model in generating abnormal returns surrounding mandatory offer announcement. The findings of this study revealed that on average market reacts positively to mandatory offer announcements and takes considerable time to fully incorporate information contained in mandatory offer announcements by the bidder firms. Further there is a considerable anticipatory effect reflect the target firms. The findings of the study will be important to all those take interest in the share market. Especially it is more important to the investors, managers of the companies' stock exchange regulatory agencies in their decision making.

Impact of domestic debt on economic growth: an empirical investigation of Sri Lanka from 1960-2014

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The main objective of the study is to identify the effects of domestic debt on economic growth in the short-run and the long-run in Sri Lanka. The study has used annual time series data for the period from 1960-2014 which were gathered from the Annual Report of the Central Bank of Sri Lanka, 2014. To analyze the data, the study used the time series econometric techniques of co-integration, distributed lag model, and Granger causality test. The study found that (i) there is no long-run equilibrium relationship between domestic debt and real value of GDP, (ii) in the short-run, domestic debt as a percentage of GDP has had a negative and significant effect on the economic growth(iii), in the long-run, domestic debt as a percentage of GDP does not have any significant impact on economic growth, (iv) there is no causal relationship between domestic debt as a percentage of GDP and economic growth in Sri Lanka between 1960 and 2014.

Technical efficiency of commercials banks in Sri Lanka 2003 - 2014: a data envelopment analysis

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The main objective of the study is to measure the technical efficiency of commercial banks of Sri Lanka between 2003 and 2014 by using basic Data Envelopment Analysis (DEA).The data was gathered from various Annual Reports of Central Bank of Sri Lanka. The study mainly used input oriented Charnes and Cooper and Rhodes (CCR) model of basic DEA to measure the technical efficiency of commercial banks. For the analysis, the study used one output variable (profits of commercial banks) and two inputs variables (total assets and shareholders' funds) between 2003 and 2014.

The study found that average technical efficiency score is 0.788 as a ten years average between 2003 and 2014. In 2012, there is no technical inefficiency in commercial banks in Sri Lanka. In other periods, there is technical inefficiency in activities of commercial banks in Sri Lanka, and in 2009, technical efficiency score is very low. In other words, among these study periods, the inefficient of use of inputs was very high in 2009 but the efficient of use of inputs was in2012 compared to other periods.

Profit maximization in a paint manufacturing plant using linear programming

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Profit maximization is a very important objective of any organization. In business, profit is used to measure the quality, value and the success of a business. Profit maximization helps to drive a business smoothly, successfully and survive continuously while providing various benefits. Profit is considered as a yardstick for the success of a commercial organization.

In this study, a paint manufacturing company in Sri Lanka was selected to maximize their profit using available resources while maintaining maximum performances. Using this study, management of the entity can decide the number of units from each size of main paint types to be manufactured and to determine which products are profitable. In other words, it is possible to find out the products which should be given more attention to maximize profit under various conditions. Also, in this project, options are checked to reduce wastage resources like money, time and physical resources etc. Their product portfolio includes five main paint product types, which are *Emulsion, Enamal, Anticorosive, Floor paint and varnish*.

To construct the model, available raw materials, labour hours, demand for each product per month, quantity of raw materials which are used as ingredients for products and their contribution per unit were collected for data analysis. Available resources and demand for products per month were considered as constraints of the model. In data analysis, *a linear programming* model was created and solved using lingo15.0 software as a Lindo model.

As a result of this study, a clear idea can be given to managers to manage the resources for optimal production. Also company can take necessary action to prepare an optimal production schedule.

Determinants of environmental reporting disclosures within the Sri Lankan public listed companies

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Environmental reporting communicates the environmental performance of a company, for example, pollution, and carbon emissions, and remains predominantly voluntary within the annual reports. The existing literature suggests that there could be three reasons for such voluntary disclosure. First, disclosure is necessary in the public interest (i.e., stakeholder view). Second, companies must meet the unstated expectations from the society if they want to continue (i.e., legitimacy view). Third, organizations' shall willingly disclose with the intention of boosting their profits (i.e., voluntary disclosure view). This paper aims to identify the determinants of the degree of environmental disclosure practices within the Sri Lankan listed companies. For this purpose, it is hypothesized that company size, industry type and profitability have positive associations with the level of environmental disclosures, respectively in line with the above three views. Companies tend to report extensively on the environmental performance when their businesses become larger, environmental sensitive and profitable due to stakeholder and legitimacy pressures and voluntary disclosure motive. The study followed the quantitative methodology.45 listed companies that adopt Global Reporting Initiative (GRI) framework were selected into the sample from a total of 291 companies listed on the Colombo Stock Exchange. Data was gathered from the annual reports of the financial year 2014/15. A disclosure score was developed based on GRI guidelines to determine the impact of company size, industry type and profitability on the level of environmental disclosures. The results of the multiple regression analysis show that the level of environmental disclosures was significantly associated with the company size. However, the relationship between the environmental disclosures and profitability was statistically insignificant. Thus, it can be concluded that the motives of the Sri Lankan listed companies to disclose their environmental performance are driven by stakeholder pressures rather than merely to improve the profits. The results of the T-Test provide evidence to claim that companies in the low profile industries disclose more information than those in the high profile industries. This is in line with the legitimacy view to protect the social contract and to improve the public perception towards the company.

Effect of perceived environmental uncertainty on the relationship between style of budget use and return on management: evidence from Sri Lanka

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In today's business environment information is plentiful; attention becomes a scarce resource. Thus, managers' attention on right things for the right amount of time is far more important. Following the notion of contingency theory, which suggests that the choice of appropriate Management Control System will depend upon the context within which an organization operates, this study examines the moderating effect of Perceived Environmental Uncertainty (PEU) on the relationship between the Style of Budget Use (SBU) and Return on Management (ROM).

Literature suggests that in a highly uncertain condition, budget requires attention from the management and vice versa in a more stable condition. This is the proposition that this study has analyzed using Moderated Regression Analysis and Binary logistic regression. For this purpose, responses of 80 top level managers from an equal number of listed companies in the Colombo Stock Exchange were gathered via a questionnaire survey.

The results of the empirical investigation support the hypothesis that the PEU significantly moderates the relationship between SBU and ROM. Positive evidence permitted subsequent analyses to show that PEU interacts with different variations to SBU and influence ROM. More specifically, under high level of PEU, diagnostic use of budget has shown a less likelihood of yielding high ROM. In contrast, under low level of PEU, diagnostic use of budget is likely to achieve a high ROM whilst interactive use of budget is less likely to achieve a high ROM. Nevertheless, the expectation of high ROM under high PEU when the budget is used interactively was not supported in the empirical study.

The results of this study therefore suggest that the interactive use of budget may have both positive and negative impacts on the ROM due to excessive management attention in a highly uncertain condition. Hence, managers need to maintain a tradeoff between diagnostic and interactive styles of budget use in a highly uncertain environment to optimize the ROM. The findings of this study is likely to help managers gain an awareness on the right amount of time to be invested in budget related activities based on their perception on environmental uncertainty.

Impact of Customer Relationship Perceptions (CRP) on customer loyalty: with special reference to supermarket consumers in Sri Lanka

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Keeping and satisfying existing customers has been found as more profitable than attracting new customers. Hence, building and maintaining strong relationships with their customers has become a basic requirement for companies today, in order to stay ahead the competitors. Therefore, the emphasis put on Customer Relationship Management (CRM) by companies shows a clear increase in the recent past. Firms aim to build close relationships with customers to enhance customer relationship perceptions (CRPs) which would lead to customer loyalty (CL).However, literature shows that the majority of past researches have considered the impact of CRPs on either customer retention or customer share while there are only few researches that studied the relationship between CRPs and CL especially within the context of Sri Lanka. Therefore, in order to fill the knowledge gap, this research focuses on the relationship between CRPs and CL with special reference to supermarket consumers in Sri Lanka. The major objectives are to determine the level of CRPs of Sri Lankan supermarket consumers, to determine the level of CL of Sri Lankan supermarket consumers and to determine the impact of CRPs on CL of Sri Lankan supermarket consumers. This study is descriptive and correlational in nature. Primary data was gathered through self-administered questionnaires where the unit of analysis was consumers who possess a loyalty card of a supermarket chain. A Sample of 180supermarket consumers was selected for the survey basing on convenience and judgment under the non-probability sampling technique. The One-Sample T Test and Regression Analysis were performed to test the hypotheses. The results show that, there is a high level of CRPs among supermarket consumers in terms of affective commitment and satisfaction and there is a high level of CL towards supermarket consumers in terms of attitudinal loyalty and behavioral loyalty. Further, findings show that CRPs dimensions positively affect customer loyalty. R^2 of 45.9 indicates that approximately 46% of the variance of CRPs is explained by this conceptual model. However, it is evident that there are other important variables that contribute to CRPs of the Sri Lankan supermarket consumers and those variables would collectively account to approximately 54 % of the variance of the CRPs. The implication of this research can be used to develop CRPs tactics in order to increase CL.

Adoption of management accounting practices in health care companies listed in the Colombo Stock Exchange and factors influencing adoption

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Health care sector is a key player of a country's economy, and there has been concerns regarding the efficiency of the public health care sector throughout the world. Therefore the involvement of the private sector in the development of the health care sector becomes important. The adoption of Management Accounting (MA) practices have the main benefits as cost saving, reaching new segments of the population, efficiency, enhancement of reputation and better customer service and satisfaction. According to Fonseka et.al (2005), the adoption of MA in Sri Lanka is low. For that study 47 companies listed in the Colombo Stock Exchange (CSE) from 6 industry sectors have been analyzed, but companies working in the health care sector have not been included in the sample. Further the factors influencing the adoption have been analyzed in general. Therefore this research attempts to use a structured framework to analyze the factors influencing the adoption of MA Practices using the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB). The sample for this study is the Health care sector companies listed in the CSE. The whole population was selected and this includes six companies. Data was collected through structured questionnaires with 5 point likert scale and interviews. To measure the level of adoption, 20 MA Practices were selected and to measure the factors influencing the adoption, TAM & TPB have been used. This study follows a quantitative approach and the data was analyzed using descriptive analysis techniques. It was found out that the adoption of certain MA practices is low in health care companies listed in the CSE. i.e. Target Costing, Management by Exception, Process reengineering, Balanced Scorecard, Activity Based Costing, Responsibility Accounting, Total Quality Management, Kaizen costing, Differential Costing, Just In Time and Theory of Constraints. The reasons for the low adoption have been identified as the less perceived ease of use of MA Practices and less knowledge of ICT knowledge among the employees. In addition to that, MA Practices such as Cash-flow Statement, Budgetary Control, Variance Analysis, Variable Costing, Ratio Analysis, Standard Costing, CVP- Analysis, Absorption Costing and Segment Reporting have a high level of adoption. The reasons for the high adoption have been identified as Perceived Usefulness of MA Practices, Attitudes of the companies towards the MA practices, External pressure and Security of the MA practices. This research would help the companies to understand their awareness of MA practices and their benefits while identifying the reasons that influence the adoption of MA practices. It can contribute to the whole economy by enhancing the efficiency of the health care sector.

Impact of brand awareness on purchase intention of mobile phone brands: in case of Sri Lankan mobile phone consumers

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Mobile phone Market can be identified as one of the most growing markets in Sri Lanka with 115% of mobile-cellular penetration by 2015 (Telecommunications Regulatory Commission of Sri Lanka, 2016) .As a result, the brand competition among mobile phone marketers has increased. In order to be successful in this context, it is important to understand the levels of Brand Awareness (BA) as well as the impact of BA on Purchase Intention (PI).According to literature, the BA acts as a critical factor on the consumer PI, where certain brands will accumulate in consumers' mind to influence the consumer purchase decision. Moreover it is argued that a product with a high level of BA will receive higher consumer preferences due to its higher market share and quality evaluation (Dodds et al., 1991). However it is evidenced that there is a lack of research conducted on the relationship between BA and PI in the context of the Sri Lankan mobile phone industry. Hence, the research problem of the present study is established to study the impact of BA on PI of mobile phone brands in relation to Sri Lankan mobile phone consumers. Accordingly the objectives of the study are to determine the level of BA and the level of PI of mobile phone brands and to determine the impact of BA of mobile phone brands on PI. The study is descriptive and correlation in nature. The population of the study was mobile phone users in Sri Lanka, while an individual consumer who is using mobile phone is the sampling element. A sample of 385 respondents has been selected based on judgmental and convenience techniques under the non-probability sampling technique. One sample T-test, mean values and regression analysis were performed to test hypotheses. Results indicate the level of BA on mobile phone brand as well as the level of PI on mobile phone brands among mobile phone customers is high. Further, it was found that there is a positive impact of BA on PI of mobile phone brands among consumers. R^2 of 30.6 indicates that approximately 31% of variance of PI is explained by BA. However, it is evident that there are other important variables that contribute to PI of Sri Lankan mobile phone consumers and those variables would collectively account for approximately 69% of variance of the PI. Hence, it would be important to direct further research on identifying the other variables influencing the PI of mobile phone brands among Sri Lankan mobile phone consumers. Findings of this study can be used by the marketers when they set promotional strategies for the mobile phone market.

Impact of brand image on customer loyalty with special reference to Sri Lankan hotel industry

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Brand Image (BI) is being recognized as an important factor influencing customer loyalty in many industries, where many companies try to attract more customers through creating a positive brand image in consumer minds. Hotels as a player in the hospitality industry, which is one of the highest competitive industries today, try to establish a strong and impressive BI in order to stay ahead the competition and to gain a competitive advantage within the present intensified competition in the hotel trade. However, it is evidenced that there is only a handful of researches conducted to study the impact of BI on CL in the hotel industry, especially in the Sri Lankan context. Hence, in order to fill the existing knowledge gap, the researchers are interested in studying the Impact of Brand Image on Customer Loyalty in relation to the hotel industry in Sri Lanka. The objectives of the study have been set accordingly, to identify the level of BI as well as the level of CL of Hotels in Sri Lanka and to identify the impact of BI of hotel customers on CL of hotels in Sri Lanka. The study is descriptive and correlational in nature. The customers who consume the hotel service of star grade hotels in Sri Lanka were the population of the study and an individual customer who consumes the hotel services of star grade hotels in Sri Lanka was considered as the sampling element as well as the unit of analysis. A sample of 100 respondents was selected on convenience and judgment which is under the non-probability sampling techniques. Hypotheses were tested by using one sample T-test, mean values and regression analysis. According to the findings, the levels of BI and CL were high among customers who consume the hotel services of star grade hotels in Sri Lanka; whereas it there is a positive relationship between BI and CL. Moreover, the R^2 value of 20.1 indicates that approximately 20% of variance of CL is explained by BI, which means maintaining high level of BI is a critical factor to maintain high level of CL. However, there are other important variables which account for 80% of the variance of the dependent variable which future research can be directed at. Marketers can adopt the findings of the study when they set relationship marketing strategies and when designing promotional strategies for their hotels to stay ahead the competition.

Measuring online service quality: with special reference to online education programmes in Sri Lanka

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As a result of the advancements made in technology, online businesses are growing at an increasing pace all over the world today. The Educational institutes, especially universities also have started to offer online certificate, diploma and degree programmes targeting pools of candidates who are seeking higher education for career advancements. The situation is no different in Sri Lanka as well with the educational institutions mushrooming around the island. However, the Sri Lankan national universities today, as public administrative bodies are highly emphasizing on maintaining the highest level of Service Quality (SQ) in today's competitive educational industry. This creates the need to evaluate the performance in terms of the quality of the services provided. Most of the past studies are focused on identifying factors affecting online education and online SQ, but not on student's expectations and perceptions towards the quality of online educational programmes, especially in the Sri Lankan context. Thus, this study intended to measure the online SQ with special reference to online education programmes in Sri Lanka. The research objectives were to identify the key dimensions of both Expected SQ (ESQ) and Perceived SQ (PSQ), and the overall level of SQ. This study is descriptive and conclusive in nature. A single cross-sectional research design was adopted to collect data through a self-administered online questionnaire. The population is the students who have registered for an online educational programme in Sri Lanka. A sample of 100 students who has registered for an online degree programme offered by a national university was extracted using the simple random sampling technique. The unit of analysis is a student who has enrolled for the above mentioned degree programme. Mean values, One Sample T-Test and Gap Score were performed to test the hypotheses. The results demonstrated that the key dimension of ESQ is 'Ease of Use' with the highest mean value. Conversely, the key dimension of PSQ is 'Credibility'. As per the Gap Score Analysis, only the 'Reliability' dimension showed a positive gap, which means that perceptions are higher than expectations, and that students are satisfied in terms of 'Reliability' dimension. All the other dimensions showed negative gaps, illustrating that the perceptions are below expectations. However, the gap between the expected and perceived SQ is insignificant. Hence, it can be concluded that the level of the overall SQ of the chosen online degree programme is high. The inferences of this research can be used in developing strategies to enhance the level of SQ of online educational programmes.

Lean manufacturing approach for reducing non value adding activities: a case study

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Non Value Adding Activities are the activities which do not add to the market form or function of the product. The customers then are unwilling to bear the cost. Thus, it is needless to say the importance of eliminating them from business operations. By using the extreme case study research method, this study aims to illustrate the procedure that a manufacturing organization has adopted in identifying and minimizing the non-value adding activities while enhancing the value adding activities in the business operation through lean manufacturing concepts and techniques. The existing literature suggests that different types of lean manufacturing techniques and tools, such as Value Steam Mapping, 5S, Process Mapping, Kaizen, Total Productive Maintenance and Lean Trainings, are likely to enhance the value adding activities of a process, and change the existing culture towards a lean environment. Data was gathered through interviews and participatory observations. 12semi structured interviews were conducted and 150 hours were spent in the case organization to collect evidence on site in the production facility. Data was analyzed in three steps, namely coding, identification of relationships and interpretation. The finding suggests that reduction of non-value adding activities is required to be carried out with an accurate purpose following four main procedures, namely Lean Principles; Lean six Sigma; Lean Tools; and Lean Training. Further, in doing so, employees in the organization should possess a 'lean mindset' and act in the 'lean way' in order to make this lean initiative successful. Finally, it is important that the organization applies a 'step by step' and 'top to bottom' procedures in making changes to the existing process and employees. By this way, value can be added on customer, employee and business perspectives.

Internationalization of accounting standards in Sri Lanka: issues, challenges and the benefits

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The move to fully compliance with the international accounting standards effective from January, 2012, primarily aims at bringing about convergence of Sri Lanka Accounting Standards and International Financial Reporting Standards (IFRS) to produce high quality accounting reports. However, literature suggests that achieving expected aims from convergence, particularly in a developing country is doubtful. First, IFRS reflects the Anglo-Saxon accounting model prevalent in the developed English-speaking countries. Second, the differences in contextual factors may cause diversity in accounting practices among countries. Third, due to the uniform financial reporting practices cost of information may be reduced, but it may not lead to improved quality in the information produced. This study therefore examines the objectives of convergence, the issues and challenges faced by Sri Lanka in the convergence process, and whether the country has actually been benefited by the convergence. For this purpose, the study adopted a qualitative research method and employed field study research method. Twelve semi-structured interviews have been carried out with a variety of stakeholders, who are involved in the convergence process, for instance, accounting standards setters, regulators, auditors and practitioners. Topics covered at the interviews included the respondent's perception about the convergence process, the benefits to the country, and the issues and challenges experienced. Respondents' views were analysed in three interactive processes, namely transcription, coding and interpretation. Attracting Foreign Direct Investment and improving financial reporting quality were identified as major objectives of the convergence. The findings also suggest that Sri Lanka is benefited by convergence with improved relevance, comparability, understandability and transparency of financial information. Nevertheless, the country encountered a number of complications during the convergence process particularly related to valuation of assets and liabilities, lack of IFRS experts, continuous amendments of IFRS, new transactions emerging from the application of IFRS, and poor planning in the convergence process. Most of such issues have not been resolved yet restricting the country to achieve the desired outcomes of the convergence. These findings are consistent with prior studies predominantly related to developing countries, and provide important implications for the accounting standard setters on how to make a smooth transition to IFRS achieving intended objectives of the convergence.

Family power in governance of family businesses: cases from Sri Lanka

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Family businesses have been widely researched over the years. For instance, scholars attempted to distinguish family businesses over nonfamily businesses using many criteria. Although there is no commonly accepted such criteria to identify family businesses. More specifically, family power has been identified as a key criterion to explain the governance of family businesses. Following qualitative research approach and undertaking four case studies this paper aims to explain the ways in which family power shapes the governance of family businesses. The existing literature suggests that among other things, family ownership and their involvement in management contribute heavily to the governance of family businesses. The notions of agency and stewardship theories propose that family power could create positive outcomes such as minimizing agency costs between owners and managers. However, it can also form governance issues due to lack of professional management, particularly when the organizations become larger. Data was gathered through interviewing directors, owner-managers, family-tied non-executive employees of the four family owned businesses, and analyzed in three interactive processes, namely data reduction, data display, and conclusion drawing and verification. The findings suggest that the ownership control influence differently on the governance of family owned businesses depending on whether the family business is single owned or multiple owned. Further, the findings also suggest that the family management plays a significant role in the governance of family owned businesses. It was revealed that the level of involvement of family members on governance vary depending on the extent the family members are represented at the directorate, managerial and non-managerial levels of the family businesses.

Impact of convergence with international financial reporting standards: with special reference to licensed finance companies in Sri Lanka

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To converge Sri Lanka Accounting Standards with International Financial Reporting Standards the Institute of Chartered Accountants, Sri Lanka made a vital decision with effect from 1st January 2012. As a developing country which is in need of growth in foreign direct investments and increased access to foreign capital markets to finance its economic growth the adoption of IFRS has vital importance.

The Banking and Finance industry plays a key role in the Sri Lankan economy through adding high value to the society by engaging in quality financial services. With the convergence of IFRS, the Finance Companies faced vigorous changes in its financial reporting. Further it is crucial to study the impact of convergence, since it is not mere accounting process but also affects to all business processes leading for more credibility in financial statements and better reflect the economic reality and insights of the financial information. Therefore this research focuses to address the impact, issues, challenges and the benefits experienced by the Finance Companies following the mandatory adoption of IFRS.

The research was conducted through qualitative exploratory research with Multiple Case Study method using 03 licensed Finance companies. Chief Financial Officers and Executives were interviewed in a series of in-depth interviews during the period from October to November 2015.Responds were analyzed through the process of transcription, coding and interpretation.

According to the findings for an effective implementation of IFRS, finance companies had to introduce new business processes and realign the existing business processes. The convergence has led to use of a variety of new and complex definitions, recognition criteria, measurement bases and disclosure requirements in the financial statements. Further the comparability and acceptability of financial information have been increased due to convergence. In contrast, valuation of assets and liabilities, resource constraints, new transactions evolving from the application of IFRS, changes in IT systems and business processes, requirement of professional judgment, high cost for training process and creating awareness among stake holders and top management were identified as key issues and challenges emerged during the process of convergence.

Findings suggest important insights to regulators and practitioners to have an effective and smooth IFRS convergence process.

Consumer acceptance of mobile value added services: a model based on literature

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The number of mobile connections exceeded the population of Sri Lanka by the year 2014 indicating that the potential customer base is diminishing. In line with the global trend, offering different Value Added Services (VAS) to the existing customer base was identified as a potential means of growth by the mobile service providers (MSPs) where the knowhow of the influential factors on the consumer adoption of mobile VAS would be important since the earnings from VAS were reported to be not substantial due to the lower adoption levels by the consumers. On the other hand, many researches were conducted on the determinants of technology adoption and usage making it a prominent research area throughout the last few decades. However, a research gap can still be identified in relation to the adoption of technologies in the consumer context as the earlier researchers have given a prominence to the technologies in the organizational context. From an extensive literature search using *Google Scholar*®, a total of 20 relevant articles published later than 2010 were identified and the factors that have been investigated in the selected studies were classified according to their similarity and patterns of their findings. Among the identified models, the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2) was selected as the theoretical base since it was specifically design for the technologies available in the consumer context. Moreover, UTAUT is an extension to the Unified Theory of Acceptance and Use of Technology which is a review and consolidation of the constructs of eight models that were used in explaining the information systems usage and behaviour.

The developed model consists of two constructs in addition to the constructs of UTAUT2 i.e. the Perceived English Language Proficiency (EL) and the Type of the Connection (TC). Having EL in the model is important as the MSPs use English as the primary language of nonverbal communication. Such dependency may act as a barrier to the technology use. TC on the other hand, indicates the major categories of mobile connections based on the billing method (i.e. pre-paid and post-paid) which may have an impact on the adoption and use of VAS.

In line with the UTAUT2, Use Behaviour (UB) has been identified as the dependent variable of the proposed model. UB was conceptualized to have direct relationships with Behavioural Intention (BI), Facilitation Conditions (FC), Habit (HB), and Experience on Mobile Technologies (EX), EL, TC and Demographic Factors (DF). On the other hand, BI was conceptualized to have direct relationships with all independent constructs (i.e. Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Price Value (PV), Hedonic Motivation (HM), FC, HB, EX, EL, TC and DF) making it an intermediary variable. However, the proposed model requires empirical validation before practical usage.

Economics and Management

Impact of the exchange rate regime change on the value of sri lankan currency

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        Different countries adopt different exchange rate policies. Sri Lanka had a fixed exchange rate system in place from 1950 to 1976. It got changed into a managed floating exchange rate system in 1977 and finally an independent floating exchange rate system since 2001. The objective of this study is to examine the relationship between the exchange rate regime change and the value of Sri Lankan currency, from the perspective of an emerging economy.

        Current state and trends of exchange rate and the value of Sri Lankan currency have been analyzed using descriptive statistics. Regression analysis has been performed to investigate the impact of the exchange rate regime change on the value of the Sri Lankan currency. The exchange rate regime change is demonstrated using dummy variables and therefore, the study classifies the exchange rate systems in Sri Lanka into three categories, namely; fixed exchange rate system from 1950 to 1976, managed floating exchange rate system from 1977 to 2000, and independent floating exchange rate system from 2001 to 2015.The value of Sri Lankan currency is expressed as the amount of US dollars per one rupee and measured using the annual average exchange rate of US dollar from 1950 to 2015.

        Findings of the descriptive statistics revealed that the exchange rate is relatively higher in floating exchange rate regimes compared to fixed exchange rate regime. It detects that the value of Sri Lankan currency has depreciated in floating exchange rate regimes. Further, regression results found out that there is a negative relationship between the value of currency and the exchange rate regime change in Sri Lanka, and that the value of the Sri Lankan rupee is lowered during the floating exchange rate regimes than the fixed exchange rate regime.

Moodle based individual learning style indication system

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Learning is an individualistic process which differentiates the preferences of the information acquiring methods. Learning style, the most preferable way of learning and gain knowledge through preferable learning activities can formulate a pleasant and enthusiastic learning environment for the learner. Hence, the learning style is a considerable factor for the sustainability of a learner-centric environment such as online learning. The perception of individual learning style can significantly enhance the learning efficiency. Although several empirical learning style models have been introduced, the Felder & Silverman Learning Style Model, which was formulated by Richard Felder and Linda Silverman in 1988 and revised in 2002, leads the popularity in research.

Learning Style Assessing and Indicating Systems (LSAIS) are required for an effortless reaching to the students. So the most appropriate platform for developing an LSAIS is the institutional e-learning system, where the students experience online learning. Moodle, as an open source Learning Management System (LMS) is the most popular LMS due to its customisability and capability of empowering feasible online learning environment.

This study discusses the development of an Individual Learning Style Indication System (ILSIS) based on Felder-Soloman Index of Learning Style Model. The system has been developed as an extension for Moodle LMS using PHP (Hypertext Preprocessor), a server-side scripting language. ILSIS includes an online Index of Learning Style questionnaire to determine the learning style of a respondent and a Moodle block to display the individual learning style with a recommendation of the best-suited learning approach. The questionnaire was developed using the Moodle Questionnaireplugin, and a Moodle block, named "Learning Style Block" using the Moodle architecture as an external plug in. The learning style block depicts one's learning style automatically after filling the on-line questionnaire in a summary format. Further, it provides a link to a detailed report which elaborates the result according to the fundamentals of Felder &Silverman learning style model. The block has been tested with 100 users, and the results were compared with manually calculated results. The correctness rate is 100%.

Student awareness of their self-learning style and the best learning approach can lead them to select the appropriate learning techniques and materials. Teacher awareness of students' learning style provides the opportunity to group the students with similar learning styles and differentiate the teaching methods. This system can be further developed to create learning style based groups in the Moodle e-learning system.

Concept of creativity and education in the light of some works of Sanskrit poetics

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The concept of creativity and education is a significant topic in some intellectual contexts such as education, aesthetics, philosophy etc. Western scholars such as Arthur j Cropley, Bob Jeffrey and Anna Craft have attempted to understand the concept of creativity and education by examining experience of teachers, lecturers, theorists, policy makers. This study attempts to carry out an examination of the literary aspects of the concept of creativity and education in the light of the works of Sanskrit poetics.

The data collected from the works of Sanskrit poetics such as *the Kāvyālaṅkāra of Bhāmaha*, *the Kāvyanusāsana of Hemacandra*, *the Kāvyamīmāṃsā of Rājaśkhara, theKāvyaprakāśa of Mammaṭa, and the Vāmana's Kāvyālaṅkārasūtravṛtti* was critically and comprehensively examined to identify the concept of creativity and education from the perspective of Sanskrit poetics.

The recommendations by the *Kāvyamīmāṃsā* on three kinds of knowledge, i.e. knowledge of past (*smṛti*), knowledge of present (*mati*) and knowledge of future (*pragñā*), seem more empirical than its theoretical aspects. To succeed in education or creativity, the learning process recommended by ancient Sanskrit poetics, i.e. first go to the teacher; second listen very well; next keep them in mind; then understand; then think logically; after that be doubtless; finally know it truly, shows the practical views held by Sanskrit scholars in ancient India. Furthermore, the elements of intuition (*pratibhā)* by Mammaṭa and the teaching of external factors such as time and place for studies and the knowledge of the world by Vāmana can be largely identified as aesthetical foundations. The ancient tradition of Sanskrit poetics has understood the fundamentals of creativity and education. In other words, the works of Sanskrit poetics have recommended the way to being successful in education and creativity with aesthetical and philosophical perspectives. The theoretical recommendations of some scholars of Sanskrit poetics seem to be more useful for today's scholarship as well. Therefore, it is worthy studying the works of Sanskrit poetics by the researchers in education and aesthetic disciplines to find some theories of practical basis related to the concept of creativity and education.

Abstract No: 127 *Education*

Pattern of internet use by undergraduate students at the Faculty of Medicine: a case of University of Peradeniya, Sri Lanka

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The way undergraduates read for the medical degree is considerably influenced by modern technology, where internet plays a major role. The major functions that the internet offers are searching information, entertainment, communication and socialization. Internet is used in the Faculty of Medicine for official work such as uploading notices, lecture notes and videos, examination results and small group discussions, tutorial questions, etc. The response of students towards these new trends has not been considered scientifically and statistically. The objective of this study was to describe the pattern of internet use among students at the Faculty of Medicine, University of Peradeniya.

A self-administered questionnaire was distributed to all the students in four batches (861) at the faculty and out of them totally 716 (83.2%) responded. Microsoft Excel software was used as the data entry package and SPSS was used for the analysis of data. The frequencies of distribution of each variable and cross tabulation when appropriate were calculated. The chi-square test was used to compare the frequencies of different variables.

A majority of the students accessed internet at the faculty (94.4%) using smart phones (84.6%) via Wi-Fi connection in the faculty (83.4%) mostly for academic purposes (99.4%) on daily basis (66.1%) for 1 to 2 hours per day (41.5%). Most had 1 to 2 years of experience (41.8%) in using internet, through self-learning (87.2%), and most of them were satisfied with their skills to use the internet (77.4%). Most popular activities in academic, social networking, entertainment and communication fields were downloading Moodle lecture notes (95.1%), Facebook (89.0%), listening to music (89.2%), and e-mail (80.6%) respectively. Most frequently faced problems were slow internet connection (63.0%), using e-data bases (41.6%) and staying longer than intended (46.5%) with no difference according to sex or academic year. According to the student perception their academic work was significantly affected due to internet use (17.1%).

The findings indicated that females used internet mainly for academic purposes while males used mainly for social networking and entertainment. Preclinical students spent significant time on academic purpose. For academic information search students mostly used search engines such as yahoo and google, which may be unreliable, compared to databases such as HINARI. It is important that the faculty play a prominent role in the organization of internet skill building courses for students to enhance their capability to adapt to new technologies.

Prospective teachers' skills of activity based lesson planning given by mathematical curriculum of the National College of Education

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Prospective teachers acquired skills of activity based lesson planning through their curriculum of mathematics during the first two years of NCoE. These skills may result for their teaching practice in internship period. The education reforms introduced in 2007 the 5E learning cycle emphasized the importance of activity based teaching. The main purpose of this study was to examine the implementation of activities for achieving the mathematical concepts in internship period. This study consisted of two phases. In the first phase data, which were perceptions of prospective teachers on the activity based teaching, were collected using questionnaire administered to 280 Sinhala medium prospective teachers, from three main NCoE which conducted mathematics courses. It was revealed that 35% of the sample was in the view that the guidance provided individually to prepare activities was not enough. However 53.8% of the prospective teachers were in the view that they were aware of activity based teaching methods through mathematical curriculum and 34.4 % of the sample greed that given instructions were enough to build up activities creatively. While 45% showed that they are directed to make activities by using various learning sources and library materials. It was revealed from the responses to the questionnaire, the prospective teachers were in the view that they do not get sufficient skills of planning and creating activities by curriculum of mathematics of NCoE. In the second phase of this study, twenty four prospective teachers out of the above number were selected for lesson observation under Gerges (2001) sampling method. Informal interviews and participant observation were used as the method of data collection and transcripts were prepared using field notes and audio records. Data were analyzed qualitatively and quantitatively. It was revealed that 66.4% prospective teachers implemented activities in exploration stage of their lessons. Out of the above the number 42% of activities resulted to develop misconcepts. All of those activities carry out under group work method. In this learning approach, most of the students did not actively participate in the given activities. In depth of analysis it was able to identify three types of activities. They were named as constructive, exploratory and non-exploratory. Non exploratory activities were not given opportunities to develop reasoning skills. According to the conclusions arrived from the study, some suggestions were made to reform curriculum of mathematics to improve the skills of activity based lesson planning of the prospective teachers of the National Colleges of Education.

Outcomes of the implementation of a task based approach in the EAP (English for Academic Purposes) classroom

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The task based approach has gained recognition as an important element in the language classroom as a method to move learners from reproductive language use to creative language use, resulting in maximum engagement in language acquisition through requiring them to draw upon their emerging language skills and resources in an integrated manner (Nunan, 2004).

The objective of this study was to explore the effects of tasks in pedagogy in the English as a second language classroom for undergraduates. This was achieved through investigating dialogic exchanges, involving noticing, formulation and hypothesis testing, produced as a result of stimulus from a pedagogical task.

A task was designed for second year undergraduates at the Faculty of Science, who are learners of English as a Second Language (ESL) following the English for Academic Purposes course. The task which was designed to reinforce structural and grammatical skills while focusing on the meaning conveyed and involved learners using and manipulating previously taught forms to fulfill the functions of the task. The task was structured to engender discussion and foster peer learning.

Learners were provided with incomplete information in the form of three short excerpts from a newspaper article. Working in groups the learners had to decide on the storyline of the article guided by the given excerpts. As the final outcome, each group had to write an article for a newspaper about the incident incorporating the given data and adding further details. The structures targeted in this task included the past tense, reported speech, lexical items and sequence markers, all of which the students had encountered in previous lessons.

The learning outcome was measured through Language Related Episodes (LRE) that occurred in the process of carrying out the task. Success in the task was measured in terms of accuracy of linguistic use and the achievement of the task.

Investigation of the LREs produced during the task showed that this task resulted in peer learning and achieved the aim of pushing learners to think about, manipulate and practice the target language features. Thus, in conclusion, well planned tasks can engender language learning in a second language context by pushing learners to notice, interact and formulate language, focusing on both form and meaning.

Education

Effectiveness of using multimedia content in programming class: a case study

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The Multimedia Content Strategy has promoted learning because it inspirits students to take an active role in the cognition process and have better control over their inculcation. Objectives of the present research were comparing mean scores of Programming Accomplishment at pre and post stages of the multimedia content group, comparing the adjusted mean scores on programming accomplishment of the multimedia content group and conventional strategy group by considering pre Programming Accomplishment as covariate and studying the consequence of treatment, gender and their collaboration on programming accomplishment by considering preprogramming accomplishment as covariate. In the experimental process of the present research, one experimental and one control group was composed. The Multimedia Content group as experimental group was edified Programming with the supplement of Multimedia Content, the control group was edified Programming through Orthodox Approach. The design involved three phases: the first stage has involved pre-testing of all the students of two groups on the Programming Accomplishment Test. The second stage of experiment treatment lasted six months. The treatment was comprised of edifying Programming to Undergraduates with Multimedia Content to the experimental group and Orthodox Approach to the control group. During the third stage i.e. post-test stage, the students ware post-tested on Accomplishment in Programming just after the treatment so as to determine the Consequence of treatment. Data has been analyzed through correlation analysis and analysis of co- variance (ANCOVA) using statistical package for social sciences (SPSS).Findings of the experiment revealed that students of the Multimedia Content group outperformed the matched students of the Conventional Strategy group. Students who taught through Multimedia Content Strategy learned more than those who taught through Conventional Strategy of teaching. The present study showed that the Multimedia Content improve Accomplishment in Programming significantly higher in comparison to Conventional strategy when groups were matched on Pre-Accomplishment in Programming.

Developing a tool for the evaluation of student's engagement in learning activities

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Active engagement in learning activity is a critical component in student learning behaviour. However, there is a scarcity of literature on how to evaluate student engagement in learning activities. The purpose of this study was to develop a tool to evaluate student engagement in learning activities.

A preliminary checklist to evaluate student engagement in learning activities was constructed with the help of existing literature and teaching experience. This checklist comprised of31 items categorized based on: Pre-activity engagement, per-activity engagement and post-activity engagement. Consensus on the items in the checklist was obtained by a Delphi survey of 8 experienced teachers at the Faculty of Medicine, Peradeniya. Internal consistency was measured using Cronbach's alpha. The tool was used on 73 1st year medical students in the Faculty of Medicine, Peradeniya and 228 pre-entry students eligible for local medical schools to evaluate student engagement prior to, during, and after an interactive lecture.

Two items of the tool were agreeable to 70%, on initial Delphi survey with one item receiving a 50% and the rest a 100% each. Consensus was defined as agreement by 70% or more participants. Such consensus was achieved on 97% of the questions in the tool. The entire tool obtained an internal consistency value (α) of 0.872 and the pre-activity, per-activity and post activity categories got 0.724, 0.427 and 0.802 respectively. The coefficient of correlation (r) calculated for student engagement versus test performance, after eliminating the outliers, was 0.103.

The tool has the face validity but concurrent validity and predictive validity need further evaluation. This could be considered as the first step towards developing a valid and reliable tool to evaluate student engagement in educational activities. It should be modified and improved further. However, feasibility with regards to need for resource persons and subjective nature of the observation and variability hinder its usefulness as a research tool.

Effect of student-engagement on acquisition of knowledge from an interactive lecture

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Active engagement is a critical component in student learning behaviour. This study explores the relationship between students' engagement in a learning activity and its outcome, in the context of medical education.

The study included 135 first year medical students from the Faculty of Medicine, Peradeniya, and 228 pre-entry students qualified for entering a local medical school. First year medical students were divided into two groups; Interactive group (group 1) consisted of 73 students assigned into smaller sub groups with an accompanying facilitator who promoted and evaluated the level of student engagement in preparation for a lecture using an evaluation tool with 31 checklist item. Non-interactive group (group 2) consisted of 62 students who were not exposed to a pre lecture activity. Subsequently a 15-minute lecture was delivered to both groups together. Following the lecture Group 1 was again allowed time for engagements and assessed using the same checklist. Both groups were assessed on the content of the lecture by an MCQ paper. A similar activity was conducted with the 228 pre-entry students. MCQ marks and scores for observed intensity of engagement were recorded.

The interactive group obtained an average score of 31.48/50 for the examination while the non-interactive group obtained 29.95/50. This difference was statistically significant at a significance level of 0.1 in a single tailed t-test. The histogram of the interactive group shows skewing towards right when compared to that of the non-interactive group. Variance for the group was 65.67 in pre entry students, 51.83 in engaged faculty students 34.08 in non-engaged faculty students. The coefficient of correlation (r) calculated for student engagement versus test performance was 0.103.

This study demonstrates a positive impact of active student-engagement on knowledge acquisition with a tendency of more students performing above average. This study emphasized the value of pre, during and post engagement of learners in educational activities. However assessed intensity of engagement did not correlate with the learning outcome measured by the MCQ test results, probably emphasizing the need for refined evaluation of engagement and assessment of outcomes.

Body composition of secondary school children in Sri Lanka: a study to develop a set of morphological fitness reference values

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The overweight and obesity prevalence among children in Sri Lanka show different ranges according to provincial and gender variations. In recent years, the interest in physical fitness assessment in school children has increased in other countries, but in Sri Lanka it is still very low. There is a dearth of reference values of physical fitness including body mass index (BMI) for secondary school children in Sri Lanka. The objectives of this study were to contribute to the available knowledge concerning the assessment of body composition (Body Mass Index), identifying sex and age-related norms of body mass index of the secondary school children in Sri Lanka and to compare BMI values of Sri Lankan children with the relevant values of children in other countries.

A quantitative approach was used in this study. Physical fitness assessments were implemented to measure BMI of 1229 students (638 boys and 591 girls, aged between 11 years and 17 years), which was a randomly selected sample in the Kandy District. All the data were computed and analyzed to formulate test norms as percentile values, stratified by chronological age groups separately for boys and girls. All the calculations were performed using SPSS vs. 17 for windows.

The significant observation is that the BMI percentiles of P5, P10, P90 and P95 of the boys in the age groups 11, 12 and 13 are greater than those of the boys in the age group of 14 years. Reasons may be due to changes occurred in adolescent period. Except this unusual pattern, it is revealed that BMI percentiles of the boys and girls gradually increase according to the age over a period from 11 years of age to 17 years. According to the data the lowest P5 of boys' BMI is approximately 13 and the highest P5 is 17 .4. Furthermore, the lowest P95 of boys BMI is approximately 18 and the highest P95 is approximately 22 .6. Furthermore, the lowest P5 of girls BMI is approximately 14 and the highest P5 is approximately 17. Furthermore, the lowest P95 of girls BMI was found for the year 18 range and the highest P95 was found in 22 .9 range.

It can be observed that although the BMI levels of Sri Lankan children (both boys and girls) are not in the range of 'Needs Improvement-Health Risk (NI-HR)' but in the range of 'Needs improvement'. They are in the margin of very lean level according to the USA norms. However, we cannot say BMI level of Sri Lankan boys and girls are not in a satisfactory level compared to USA standards. It should also be noted that since these figures are normative base values, such norms are identical only for a specific population.

Exploring the readiness and perceptions of undergraduate students towards the use of mobile phones for learning: a study based on undergraduates of the Faculty of Arts, University of Peradeniya

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It is now recognised that mobile devices add new dimensions to teaching and learning and has become an important educational tool in higher education. Research findings show the potential use of mobile devices in enhancing the teaching-learning processes in higher education institutes. It is recognised that the students' readiness is an important factor to be considered when integrating new technology such as mobile phones into an educational institution. This study explored the readiness, and the perceptions of undergraduate students of the Faculty of Arts, University of Peradeniya towards the integration of mobile phones in enhancing their learning. The objectives were, to (i) investigate whether the students from the Faculty of Arts currently use their personal mobile devices for educational purposes, (ii) identify the perceptions of the students towards the use of mobile phones for teaching/ learning and (iii) investigate whether students are ready to adopt the use of mobile devices in the classroom. As the sample, 300 undergraduate students from the third and fourth years were selected purposively. The research approach was mixed methods. Quantitative data were collected by administrating a survey and qualitative data were collected by conducting focused group interviews with purposively selected 50 students. Quantitative data were analysed with the use of SPSS. The thematic analysis technique (with NVivo10 software) was used to analyse the qualitative data. According to the findings, all the students (100%) had their own mobile device and 83% of students have been using them for learning purposes. Further, it was found that the students were facing problems when using mobile devices for learning. These include not having adequate competence in exploring the educational potential of mobile devices, technology issues and financial issues. The majority of students (89%) were ready to use mobile devices for their university education and they perceived that the integration of mobile phones would enhance their teaching-learning activities and the efficiency of administrative activities of the Faculty.

Junior secondary science teachers' views about science teaching

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Teaching students to think is one of the most essential goals of schooling. Science adds its unique skills to fulfill this goal. Science knowledge, skills, experience, and attitudes of a science teacher play a major role in inculcating scientific thinking in students. In Sri Lankan education system, science is introduced as a subject for grade six. Therefore, this research study is an attempt to understand the above factors of the junior secondary science teachers [JSSTs] towards science teaching.

All the teachers who taught science for grade 6 students [101 JSSTs of 80 schools in Gampola zone] were selected. The sample represented a cross section of school types in Sri Lanka. This research is mainly quantitative. Quantitative data were obtained by a survey questionnaire. The survey was done as the initial step of a workshop to "Inculcate novel teaching techniques for the level of JSSTs". Teachers' views were questioned and discussed in depth under two groups and the outcomes were audio recorded, transcribed and coded for content analysis. Descriptive analysis of quantitative data was done by using SPSS.

Teachers were from different age groups while teaching experience varied from one to thirty five years with different educational backgrounds. From the sample, 96% of the teachers identified themselves as special and different from other teachers in the school. About 76.2% took teaching science as a challenge with positive attitudes. However 80.2% believed that they had not acquired enough experience to teach junior secondary students. Even though 71.3% had confidence about their teaching abilities, only 63.4% had clear understanding about the science concepts to be taught. Physics was identified as a difficult subject area to teach (61.4%) while 17.8% considered Chemistry is difficult too.

This research showed that teachers were enjoying teaching with positive mindset regarding alternative teaching methods and introducing innovative teaching methods. Since, 52.2% of teachers were in charge of science classes from grade six to eleven, textbook-centered teaching process is adopted due to the heavy workload. This need to be address by the Ministry of education since junior secondary students need more inquiry-base teaching system to improve their science processing skills if we hope to prepare our young children to be future science problem solvers.

Private tuition for G.C.E. (A/L) and university entrance: findings from the University of Peradeniya

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Attempts by students to pass GCE (A/L) to follow private tuition, may exhaust them possibly leading to poor performance after university entrance. A questionnaire was administered to investigate the students on various types of tuition classes attended, number of attempts of A/L and choices of the respective faculties of study. Altogether 103 undergraduates from Faculty of Allied Health Sciences (AHS); 61 from Faculty of Veterinary Medicine and Animal Science (VET); 39 from Animal Science and Fisheries (AS) and 44 from Agricultural Technology and Management (AGRI) participated in the study.

The most popular (79-84%) was "Revision" while "Individual" tuition was attended by few (0-8%). "Papers" are equally popular (77- 84%). As the attempt advances, the students avoid "Theory" but attend "Revision" and "Papers". A total of 9/103 from AHS, 6/61 from VET and 3/39 from AST never attended any tuition. The highest proportion of students who entered the faculty preferred in first attempt was for VET (10/61) followed by AS (4/39). The highest proportion who entered in their third attempt was AS (26/39) followed by AHS (54/103). A total of 22/193 from AHS, 6/61 VET, 13/39 from AS and 20/44 from AGRI are following courses that were not even their 3rd choice. The numbers who applied for AHS as their first, second and third choices were 6, 11 and 64, respectively while the similar numbers for VET in their first, second and third choices were 5, 1 and 49 respectively. From 39 in AS, and 44 in AGRI, the numbers who applied AS and AGRI as their first, second and third choices were 4, 8, 12 and 8, 6 and 10 respectively.

Most undergraduates have followed private tuition, enter at their 3rd (last) attempt and are in faculties not preferred by them. If their attitudes are not changed immediately after university entrance, their maximum potential to study cannot be tapped. School education must be enriched and strengthened in order for prospective undergraduates to attend to extracurricular activities during school time and be psychologically better and stable thereafter.

Exploring agriculture undergraduate students' learning preference for self-directed learning

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Self-directed learning (SDL) is a fundamental educational goal based on lifelong learning. Therefore, poor academic performance among undergraduates is due to restrictions for adopting SDL. Thus it is worthwhile to explore the SDL of Agriculture undergraduates in University of Peradeniya, Sri Lanka. Therefore, the objective of this study is to explore the preference of undergraduates of Faculty of Agriculture for SDL.

The methodology was mainly quantitative. Questionnaire with closed ended questions was used as the research instrument. However, some open-ended questions were also included in the questionnaire in order to get little in depth information. Sample of 146 Students who have immediately completed the undergraduate degree program in the Faculty of Agriculture, University of Peradeniya were selected using simple random sampling. The questionnaires were posted and students were requested to return the completed questionnaire. Ninety-eight completed questionnaires were returned within the period of two months. Quantitative data were analyzed using Statistical Package for Social Science (SPSS). Chi square test of independence was performed to identify significant relationships.

The response rate was 67.12%. Results revealed that, the highest percentage (61.2%) preferred if the lecture is incorporated with SDL activities, followed by second highest percentage of 36.7% preferred to study their own way with the guidance of the lecturer. However, some students (2.0%) preferred other methods such as getting information 'through internet' and 'e-learning'. But none of the students preferred to listen to lectures only. Meanwhile, the highest percentage, 77.6% was familiar with the term 'self-directed learning' whereas 9.2% were not and 13.3% did not have an idea of it. There is a moderately strong significant relationship between the familiarity of the term SDL and the preferred way of learning (p=0.014). Students stated that less SDL activities incorporated with lecturers and with tight work schedule in the faculty they do not have time to study their own way.

The study implies the motivation of undergraduates towards SDL. However there were some issues such as less SDL activities incorporated with teaching process. Therefore, it is necessary to incorporate more SDL activities with the teaching process. Instead, improving familiarity towards SDL among undergraduate students and allocating more time for their own learning would augment SDL in undergraduate students.

School based management in Sri Lanka: experiences of school development committee members

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The School Based Management (SBM), known in Sri Lanka as the Programme for School Improvement (PSI) is a central element of World Bank's support under the Education Sector Development Framework and Programme. This study aimed to investigate the experiences of School Development Committee members on the implementation of Programme for School Improvement. This is a qualitative study; a case study approach was used to study the research problem. Research methods included document survey, semi structured interviews, informal discussions and informal observations. Participants were selected purposively, principals from three selected schools, three deputy principals, nine teachers, nine past pupils and nine parents who were the members of the School Development Committees (SDC) in the schools in the Colombo district. Thematic analysis was used for analysing the data in this study. It was revealed that, at the initial stage, the SDC members have been provided training on the PSI; however it had not been continued. The majority of participants believed training and awareness as a very essential factor. All the schools have not correctly followed the guidelines for selecting their SDC members. Participatory decision making style had not been adopted by the majority of schools. Although the SDC meetings were not regularly held, the decisions were approved informally. The effectiveness of school based teacher development depends on the interest of the principal and the staff. Since all the schools organise activities for educational development of the students, performance is not satisfactory. Schools face various challenges in implementing the PSI. For instance, lack of resources, less commitment of the stakeholders, lack of training and awareness of the SDC members, full autonomy has not yet been provided to the schools. Therefore, schools should be more independent in future, and a supervisory body needs to be established to supervise schools, and rural schools must be given an extra support.

Professional development of secondary science teachers

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The professional development is an essential aspect of teacher education. Especially with the introduction of curricular reforms in science teaching in 2015, teachers in-service need to update their knowledge and skills required for professional development in order to implement reforms successfully. The aim of this study is to enhance professional development of secondary science teachers through workshops. This study was planned according to the mixed method approach including three main phases; need survey, planning and conducting workshops and obtaining teachers' views on participation in workshops. A sample of sixty secondary science teachers was drawn from Kegalle education zone using stratified random sampling. Data were collected with the use of teacher questionnaire, participant observation, semi-structured interviews and documents. Quantitative data were analyzed using descriptive statistics while qualitative data were analyzed using thematic analysis.

Teacher responses revealed that 69% of them had only one opportunity to enhance subject matter knowledge while 18% and 10% had two and three opportunities respectively. Sixty eight percent of the sample responded that they need guidance to organize activities in classrooms especially for competency 2 and 3 in the grade six science syllabus which focused on state of matter and energy. Furthermore higher percentage of teachers (83%) responded that they need guidance to organize lessons for a given competency. The results of the need survey showed that 64%t of them were in the view that they need to be aware of new methodologies and assessment techniques for teaching science. Five themes would be identified by analyzing qualitative data gathered through participant observation and interviews. Those themes were teachers' active involvement in group work, motivation towards acquiring new methodologies and assessment techniques, use of skills and experience acquired through workshops in their own teaching and developing hands-on experience by engaging in activities and participants' satisfaction towards organizing workshops.

Professional development of the secondary school science teachers' in-service can be achieved through well prepared workshops conducted by knowledgeable experienced resource persons once the teachers' professional needs are identified.

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Research output of the University of Peradeniya in PubMed database from 1995-2015

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PubMed is a free database on Medical Sciences, which contains bibliographic records of Medline of the National Library of Medicine (NLM) and abstracts on life sciences and biomedical topics.

The present study is a bibliometric study conducted to find out the research output of University of Peradeniya. A search was conducted in University of Peradeniya in the affiliated field and 558 records were retrieved. This was analyzed using BibExcel, a tool used to analyze bibliographic data.

The first analysis was done to find out the place of publication of the journals in which the articles authored by the scholars of university of Peradeniya. 185 publications were published in journals published in England followed by 114 in the United States and 54 and 45 in Netherlands and Sri Lanka respectively. The highest number of articles was published by Kularatne SAM and the number of articles was 27. Nineteen articles were published by Tilakaratne W. M. and 15 articles were published by Maduwage K. and Kodikara, S., Kularatne S.A.M. Maduwage, K. and Kodikara S. are attached to the Faculty of Medicine and Thilakaratne W.M. is attached to the Faculty of Dental Sciences of the University of Peradeniya. When the subjects of the articles were analyzed according the Medical Subject Headings (MeSH) thesaurus given in the database 330 articles were found to be on humans, 228 articles on females and 219 articles on males. The type of publications by the Sri Lankan Medical scientists fall into the categories of 110 journal articles, 76 journal articles with research support non US govt., 26 case reports and 20 reviews. 45 articles were published in Ceylon Medical Journal and that is the highest number of articles published in a single journal. 13 articles were published in BMC Research Notes and in the Journal of Oral Pathology and Medicine.

The results showed that the Sri Lankan medical scientists have published more in UK based journals. The Ceylon Medical Journal is the most popular local journal with the highest number of publications. The results showed that the highest contributors to PubMed database were Medical and Dental Scientists.

Task based approach to teaching prepositions of place and direction to undergraduate students

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Task Based Language Teaching is considered as an effective teaching approach where the Second Language is taught using the tasks to which the language becomes the tool. Thus it is an approach which is goal- oriented, reflecting real life language use and language need. This task based activity is designed to teach prepositions of place and direction to the Undergraduate students who are following the 1st year English course at the Faculty of Science, University of Peradeniya. The main objective of the Task Based activity is to teach the students' prepositions of place and direction in an interesting and a student- centered arena.

For this purpose 40 1st year students were selected from the Faculty of Science and they were randomly divided into 5 groups with 8 members in each group. A map of the Faculty of science was provided to each group. On the map different directions to different locations were marked and the given directions were different from that of one group to another. Each group was presented with the directions to the given destinations without providing the name of the final destination. The other groups had to follow the instructions and the directions and they had to guess the final destination. On the next level, after an introduction to the lesson, the students again performed the activity with better knowledge on prepositions.

The above mentioned task made the students use the prepositions to express the location and directions to different destinations, as in real life. Since the students were given a goal to find the correct destination all the students actively participated in the activity. Moreover the students got the opportunity to raise their problems related to the lesson after the practical usage of the preposition. As the activity is an integrated activity of speech and listening skills, the students got the opportunity to improve their speaking as well as listening abilities in collaboration with the grammar lesson.

The task based teaching activity was very successful because, the 40 students actively engaged in the lesson and successfully completed the worksheet on prepositions.

Relationship between biology students' G.C.E. (A/L) results and their mathematics results at G.C.E. (O/L): a case study in Bandarawela educational zone

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The G.C.E. (O/L) and the G.C.E. (A/L) Examinations are the milestones in secondary education which determine the golden key to admirable future to Sri Lankan students. According to the available statistics the achievement level of students at the G.C.E. (A/L) is still less than the expected level despite the annual allocation of human and physical resources by the Sri Lankan government with the aim of improving students' performance. This could be due to several interrelated factors such as lack of interest, poor academic abilities, poor teaching methods, weak teacher characteristics and other related issues. This study focuses on finding the relationship between biology students' G.C.E. (A/L) results and their mathematics results at G.C.E. (O/L).This is a mixed method study. Questionnaires, documents, and semi-structured interview schedules were used in the data collection process. The sample included of167 G.C.E. (A/L) Biology students from Bandarawela Educational Zone. Data analysis was performed through basic statistical procedures and qualitative data analytic techniques. Results show that the high percentage of students who pass their G.C.E. (A/L) examination at their first attempt had "A" Grade for their G.C.E. (O/L) Mathematics compared to the students who had low results for their G.C.E. (A/L).Moreover, high percentage of students who obtained more than "S" Grade for G.C.E. (A/L) Physics were the students who had "A" Grade for their G.C.E. (O\L) Mathematics. The high percentage of students who passed their G.C.E. (A/L) examination at their first attempt was the students who have sat for their both G.C.E. (O/L) and G.C.E. (A/L) examination at the same school. Thus, G.C.E. (O/L) Mathematics results directly affect for G.C.E (A/L) Biology students' performance at the examination. Interview data reveals that the students' G.C.E. (A/L) Biology stream results are better when they have enthusiasm in all sections in G.C.E. (O/L) Mathematics. Further, the change of the school after their G.C.E. (O/L) could also affect students' performance at G.C.E. (A/L) in the bio-science stream. Hence, these findings could be considered in remedying the prevailing situation through suitable practices to enhance the status of science education in Sri Lanka.

Students' achievements and motivation on "molecular shapes" at G.C.E. (A/L) chemistry: a case study in Mawanella educational zone, Sri Lanka

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The evaluation reports published by the Ministry of Education reveal that the students' performance on "molecular shapes" in chemistry at the G.C.E. (A/L) examination is considerably low. It reveals that only 32% of students answered correctly to the questions of molecular shapes. This tragic situation could affect students' university entrance too in Sri Lanka as students have to obtain high marks at the G.C.E. (A/L) examination for university admission. However, there is a dearth of research on the above aspect in remedying the situation. Thus, this study aimed at exploring students' achievement and motivation on "molecular shapes" at the G.C.E. (A/L). This was conducted at Mawanella Educational Zone in Keglle District. The findings of this study will help in remedying the issue and to increase achievements in chemistry especially in the unit of molecular shapes. Both quantitative and qualitative methods were used in the data collection process. A convenience sampling technique was used in selecting the sample for the study. The sample consisted of 87 G.C.E. (A/L) students and six chemistry teachers from three schools. A questionnaire was used to investigate the students' achievements and motivation. Interviews were used to explore the teachers' opinions. The data analysis was conducted using MS Office Excel 2013.The results revealed that 83% of students were of the opinion that chemistry is not hard while 44% of students had selected chemistry as their preferred subject. Around 52% of the students had selected inorganic as a preferred section in chemistry and 51% of students agreed that they can understand "Molecular Shapes" if they work hard. Many students (94%) accepted that the theory related to concepts of molecular shapes is clear. However, students' achievement in molecular shapes is at a low level. Hence, though students have the enthusiasm towards molecular shape, still they are poor in elucidating the molecular shapes due to lack of hands-on experience in the learning process. According to teachers, most of the lessons in this aspect are conducted using the lecture method. Thus, students are in a problematic situation as it is difficult for them to imagine three dimensional orientations in the shapes of molecules. If students are taught with a lot of teaching aids and some animated programmes using new technology, they may find easy to grasp the concepts. Thus, a new approach of teaching is suggested to overcome the issues in the lessons of molecular shapes at the G.C.E. (A/L) to enhance students' meaningful learning.

Design of Colombo city electricity network for anticipated future demand

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Colombo is the capital city in Sri Lanka and it needs the highest day time electricity demand in the country. Colombo city is geographically divided into nine zones based on the major developments in "Colombo City Development Plan – 2020" published by Urban Development Authority (UDA) of Sri Lanka in 2008. The major development projects proposed to be completed by 2020 are located in concentrated development zone and the port related activity zone. With the upcoming projects, the amount of electricity demand in each zone will increase and existing electricity supply network will not be able to cater to the predicted demand.

This paper focuses on designing an upgraded, adequate and reliable network for Colombo city in 2021. Furthermore, this analysis is carried out to determine the optimum transmission voltage in 2021 to meet the anticipated demand growth.

The demand forecast is prepared up to 2021 based on past generation data and future requirements (bulk demands) obtained from relevant authorities. Then, Sri Lankan power system is modeled using the PSS/E (Power System Simulator for Engineers) software and the existing Colombo city electricity network is simulated to identify the weak areas to be reinforced for future requirements. Simulations have been carried out for two network topologies with two different voltage levels, 132 kV and 220 kV proposed to be used in the year 2021. The results obtained from the simulations include, network load flow, voltage at different busbars, short circuit levels and transmission losses. A Techno-Economic analysis has been carried out to determine the most effective network for Colombo city in 2021.

Engineering and Built Environment

PAPER NOT PRESENTED

Solving the problem of traffic congestion in Kandy city using a minimum cost network flow algorithm

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Traffic congestion is a problem faced by almost all cities around the world during the peak hours of the day. Over the time, experts have employed different methods to overcome this problem. One such approach is the use of network optimization algorithms to find the optimum traffic flow in the road network.

In this report, it is attempted to find an optimum traffic flow plan to overcome traffic congestion on roads leading to Kandy city, and to illustrate the use of above mentioned algorithm to solve the problem of traffic congestion.

In solving this problem, a minimum cost network flow is used with upper and lower bounds on the flow along each arc. They indicate the maximum and minimum capacities of the road segment represented by the respective arc. The costs assigned to each arc represent the suitability of the respective road segment for vehicle transportation considering factors like the capacity and the condition of the road (lower the cost higher the suitability). Nodes represent junctions in the road network and arcs represent road segments connecting each junction. An optimum traffic plan was obtained using the above method based on the data available.

Although this study is carried out based on the data related to Kandy city, this method could be used to find an optimum traffic plan for any road network to overcome traffic congestion when the relevant data are available.

As the final solution to this problem is highly dependent on the maximum allowable traffic flow along a particular road and the cost involved, it is very important to find a reliable and efficient method to find those values based on the condition and the capacity of a particular road.

Physics-based initial guess of conjugate gradient method for solid element analysis

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Physics-based initial guess of Conjugate Gradient (CG) method for solid element analysis is proposed by using the meta-modeling theory which allocates structural mechanics as a mathematical approximation of continuum mechanics. Based on the meta-modeling theory, the finite element analysis can be readily classified as the solid element analysis which is the most accurate and the structural element analysis which is an approximation of solid element analysis.

The basic idea of this study is to use an approximate solid element solution which is converted from a beam element solution, as the initial solution (initial guess) of the CG method for solid element analysis. The meta-modeling theory ensures that the most suitable beam element solution is the closest to the solid element solution since a distance between them is rigorously defined in a function space of continuum mechanics the improved CG method has the capability to significantly reduce the computational cost that is needed for solid element analysis. Therefore, this study promotes the use of solid element analysis in engineering problems. Displacement controlled static analysis of a frame structure is considered the numerical example of the proposed CG method. The results show that the number of iterations is drastically reduced in the proposed CG method compared to the ordinary CG method. There is hope that this reduction of computational cost of solid element analysis will be more significant with the magnitude of the problem targeted.

In the future, authors are planning to develop a physics-based preconditioning for the CG method which is more effective than the physics-based initial guess of the CG method. While there are numerous mathematical studies about pre-conditioning for the CG method, as far as the authors have studied, there is some possibility for physics-based preconditioning which employs the meta-modeling theory, and authors are presently working on it.

Engineering and Built Environment

Seismic assessment method for RC elevated water tanks

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The seismic response of elevated reinforced concrete (RC) water tanks depends on the geometry of the tank, material properties, and earthquake characteristics such as frequency content, peak-ground acceleration, and duration of the earthquake. Model analysis and response spectrum analysis as linear analysis and pushover analysis and time history analysis as nonlinear analysis methods can be employed to study the seismic response. In this study, lateral deformation characteristics of a RC Intz type elevated water tank with a $1200m^3$ capacity was examined using model analysis and nonlinear pushover analysis with the help of a finite element model developed using MidasFea program. Natural periods of the tank were extracted from the model analysis. The first three natural periods were found to be 1.8 sec in translational mode, 0.44 sec in vertical mode, and 0.35 sec in local mode. The lateral load-deformation relation of the tank was obtained using pushover analysis of a three dimensional finite element model developed incorporating both large deformation and material nonlinearity. Material nonlinearity of concrete was simulated using total strain crack model, which has been developed based on the modified compression field theory proposed by Vecchio and Collins. And Von Mises plasticity model was employed to simulate steel material behavior. The concrete mass and embedded reinforcements were modeled using the solid elements and reinforcement bar elements respectively. A lateral displacement of 450 mm was applied incrementally at the top level of the stem of the tank and the total lateral load carried by the tank was monitored. The stresses on solid elements along the tank walls were checked at different levels of lateral displacements. The results showed that the steel bars are about to yield at displacement levels of around 100 mm and concrete crushing does not occur at this displacement level. When the displacement exceeds around 100 mm, nonlinear behavior could be clearly observed. The analyses were carried out until lateral displacement reached 450 mm. At this level, concrete crushing was observed and stresses exceeded yield stress of steel.

Average shortest squared distance metric for trajectory comparison in event detection applications

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In the context of machine learning, pattern recognition and event detection plays a major role because of the increased threat of terrorism and crime. It is widely used in applications such as traffic flow analysis and video surveillance in security applications.

According to literature, the most frequently used way of recognizing patterns in a given video is extracting sets of feature trajectories of different features from the video and classifying them based on their pair wise disparity. In event detection, it is essential to identify the location trajectory of an object correctly. In this study, it was attempted to classify location trajectories based on the shape alone. Although the most suitable metric in the literature is Hausdroff distance metric, the spectral clustering which is the classification algorithm to be applied for the metric requires a symmetric disparity metric. Therefore, this was not used due to the asymmetry. Dynamic Time Warping (DTW) was the most suitable distance metric on which spectral clustering could be applied. All the same, it captures both shape and directional information of trajectories.

ASSD is basically a metric which measures the disparity between two location trajectories. In this study, for given two location trajectories, first the longer one was identified. Then, for a given point on the longer location trajectory, the Euclidean Distances with respect to each point on the shorter location trajectory was computed and the shortest value was identified. This computation was repeated for all the points on the longer location trajectory, and the average value of all such computed shortest Euclidean distances was obtained. This average value was considered as the disparity measure between the two considered trajectories.

For a set of location trajectories extracted from a video stream, both DTW and ASSD metrics were applied in parallel, and the obtained results were compared; hence the fact that the desired results can be obtained using the proposed method was justified. Further, the significance of the proposed method in pattern recognition and event detection applications was illustrated through this work.

Development of a lower-limb exoskeleton robot for gait rehabilitation

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Diseases such as stroke, Parkinson's, brain and spinal cord injuries that affect the functional motor abilities are increasingly found among elderly population in the present society. Patients with such diseases have to undergo clinical rehabilitation. Biorobotics devices such as exoskeleton robots have the potential to increase the effectiveness of clinical rehabilitation. This paper proposed a four Degrees of Freedom (DoF) lower-limb exoskeleton robot for gait rehabilitation. It can generate hip flexion – extension, and knee flexion – extension motions of both left and right limbs. The robot consists of 6 main components: hip attachment, hip joint, length adjustable thigh linkage, knee joint, length adjustable shank linkage and ankle joint.

A computer aided design (CAD) of the exoskeleton robot is first developed by considering the design factors; joints and linkages design, safety mechanisms, and human-robot interfacing. Aluminium alloy (7075) and Nylon101 are used in linkages and other structural components respectively to reduce the overall weight of the structure. Ensuring safety of wearer's limbs from perilous rotations is a prime concern. Therefore, both mechanical limiters and software feedback control are used to keep the joint rotations within safe limits. In order to interface the robot with the human wearer, thigh and shank linkages are designed to have adjustable lengths to accommodate different body sizes. Furthermore, a spring mechanism is inserted in each link to absorb the impulses while walking. Two DC motors fixed at the hip and knee joint assemblies are used to actuate the robot. Each joint angle is measured from potentiometer feedback. A PID controller is used to generate the required motion based on rehabilitation algorithm.

A finite element analysis proved the mechanical strength of the components under desired loading conditions throughout the gait cycle. A motion analysis experiment was conducted giving an input signal of a sinusoidal wave for hip joint and knee joint to verify the motion generation of the robot. Maximum motion range for both joints were obtained and this result substantiate the accordance of the robot with applicable motion ranges of human lower-limb. Further experiments conducted using *SimMechanics* demonstrated the compliance of the joint velocities for arbitrary input signals. The results validated that the proposed exoskeleton robot has adequate structural integrity and proper accordance with human motion.

Trajectory refinement using wiener filter method for video surveillance

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Motion pattern analysis in a crowded area has become a major research area in computer vision research as a result of the many promising upcoming applications; including but not limited to intelligent surveillance, safety evaluation and behaviour analysis. This paper focuses on a specific problem related to human motion pattern classification and proposes a methodology to refine the trajectories extracted from a given video sequence.

The detection of moving objects uses a background subtraction algorithm based on Gaussian mixture models. Morphological operations are applied to the resulting foreground mask to eliminate noise. Then blob analysis is performed to detect groups of connected pixels, which are likely to correspond to moving objects. Next, motion trajectories are extracted by tracking the centroid of each blob. The motion trajectories thus extracted, are observed to contain a considerable amount of interferences when comparing with the actual motion path of a person.

It can be observed that with the relative motion of limbs, the blob area of a tracked person changes with each frame. This area fluctuation can be separately extracted by tracking the blob area at each frame. Moreover, the area fluctuation of the blobs and the interferences in the extracted trajectories are found to be highly correlated.

The method that that is generally used to address this issue is fixing the blob area thus completely eliminating the impact of blob area variation. The blob area variation information by itself can provide some valuable information about the actual motion pattern, such as the proximity to the camera. Therefore, it is evident that the elimination of the impact of blob area variation would lead to a loss of important information. Hence, the methodology proposed in this study is to eliminate the effect of the aforementioned interference in trajectories by exploiting the principle of correlation cancellation of Wiener filter.

An experiment was carried out on a real video stream which contained human motion patterns, to test the applicability of the proposed methodology. It is evident through the results that human motion pattern classification accuracy can be improved to a significant level, by incorporating the proposed trajectory refinement method.

Convenient method to seal dye-sensitized solar cells

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Solar energy, the most promising source of renewable energy that is readily available can be used to produce electricity with many different photovoltaic technologies. Dye-sensitized Solar Cell (DSC) is one such technology that facilitates the fabrication of cost-effective and environmentally friendly devices. DSC consists of a working electrode comprising of an interconnected nanoparticulate mesoporous semiconductor material (typically TiO_2) on to which a sensitizer has been adsorbed, a platinum-based counter electrode and an electrolyte containing a redox couple. DSCs can be classified based on the physical state of the electrolyte, depending on which the liquid state, solid state, quasi-solid state, gel-polymer DSCs are termed. Even though the liquid state DSCs have reached a certified maximum energy conversion efficiency of 11.9%, long term stability of these devices is limited, mainly due to the volatility and the leacheability of the liquid electrolyte. In order to overcome these problems, solid states DSCs have been developed as an alternative. However, the maximum efficiency of the solid state DSCs is limited to 5% due to the poor contacts at the interfaces of the different layers.

The objective of this study is to develop DSCs with a minimum volume of the liquid electrolyte just enough to fill the pores of the mesoporous semiconductor particle matrix, and to seal the liquid using a graphene film that is deposited on the top surfaces of the particles. In order to achieve this, the working electrode is fabricated by following the usual procedure and then, a few microliters of I^-/I_3^- based electrolyte are added to the working electrode. It is then allowed to penetrate through the mesoporous TiO_2 layer. The excess electrolyte is then wiped off and graphene is deposited on top of the working electrode to cover the liquid electrolyte and thereby to minimize the solvent evaporation. This also helps the sealing of the cell which otherwise challenging with liquid electrolytes. The fabrication of the device is then completed by the addition of a platinized fluorine doped tin oxide (FTO-Pt) counter electrode. These devices are then characterized by obtaining current-voltage (*J-V*) curves. Parameters such as the thickness of the dense TiO_2 layer, thickness of the mesoporous TiO_2 layer and the time allowed for I^-/I_3^- based electrolyte to penetrate through the anode were completely optimized.

Finally, a maximum photoelectric conversion efficiency of 5.20% was achieved with an open circuit voltage of 700 mV, a short circuit current density of 10.1 mA cm^{-2}, and a fill factor of 0.74 under simulated one sun irradiation (AM 1.5 irradiation with 100 mWcm^{-2} intensity).

Motion pattern analysis in video streams based on spectral clustering

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Motion pattern analysis in video streams is currently being used in numerous applications including traffic surveillance, crowd movement monitoring, abnormal event detection, vision based counting systems and many other visual monitoring applications. In all these applications, two fundamental steps are performed; extracting motion trajectories of objects of interest in the given video stream and classifying them based on their similarities using a suitable clustering algorithm. This study proposes a methodology to accomplish the latter stage of the motion pattern analysis process.

Two fundamental issues addressed in motion pattern analysis are identifying the number of clusters in a given scenario and grouping each event into the appropriate cluster. According to literature, it is evident that the most refined clustering method available to achieve both the above tasks, is Spectral Clustering. The standard Spectral Clustering algorithm has two free parameters, K and σ; that has been set in an Ad-hoc manner. This study proposes a method of selecting the value of K, which is the number of clusters through an eigen value gap based analysis.

According to the proposed methodology, the eigen values of the Laplacian matrix obtained using the definitions in the standard Spectral Clustering algorithm are first sorted in descending order. Then, the Eigen value gap plot is derived by obtaining the differences between consecutive eigen values. Through this work, it is found that the largest Eigen value gap index provides an accurate value for K, closely reflecting human intuition. Further, the impact on K for variations of σ is analyzed by observing the event detection results for different selected σ values.

The accuracy and the validity of the proposed method are justified by applying the results of the proposed algorithm to a given scenario. This algorithm provides accurate results for different scenarios and has the flexibility of adjusting accurately to detect events in any given scenario by setting the parameter σ appropriately. Further, it is evident that the proposed methodology provides more insight to a given motion pattern analysis problem than when using other existing algorithms.

PAPER NOT PRESENTED

Validation of Open-FOAM as computational fluid dynamics software through experimental aerodynamics

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This research aims to validate the Open-FOAM (Field Operations and Manipulations) by conducting aerodynamic testing on the Clark Y 14 (CY14) aerofoil model with an Educational Wind Tunnel (EWT). The lift - c_l and drag - c_d coefficient variations of the model have been experimentally measured for Angle of Attack (AoA) ranging from -8° to +20°. Further, the total drag that acted on the CY14 was separately measured using the wake survey method.

According to the general trend, Computational Fluid Dynamics (CFD) underestimates the lift coefficient compared to wind tunnel experiment. It is as high as 24 % at a low AoA, but it reduces to 9 % at a higher AoA. However, both methods reveal that the aerofoil behaves in linear fashion for AoA ranging from -2° to +6° having the same lift curve slope of 0.1 / degree. Moreover, the CY14 has a maximum lift at 12° and stalls at 14°.

The predicted pressure drag coefficients were much lower compared to CFD and wake survey methods as expected. Nevertheless, a considerable overestimation of the pressure drag was observed for high AoA. This could be related to insufficient pressure taps towards the trailing edge (TE) of the aerofoil. When considering wake survey drag results, the simulation values were more than twice the experimental values. These high values were due to the fact that though CFD turbulence models generally assume a complete turbulent flow within the boundary layer (BL), in reality, an aerofoil has a mixed BL (A combination of laminar and turbulent flow).

In conclusion, Open-FOAM numerical simulations underestimate lift of CY14 airfoil compared to wind tunnel testing. Although the direct root cause for this cannot be figured out, it may be related to the refinement level of the computational mesh. A new turbulence model which is capable to handle a mix flow within the boundary layer is essential for more accurate estimations of the drag. In spite of inaccuracies of numerical values, Open-FOAM has predicted an overall aerodynamic behaviour of the CY 14. Therefore, new software could be used for aerodynamic designs, but that may generate slightly over designs.

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Microwave assisted method for the decomposition of asbestos-cement composites

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The rapid development in the areas of construction in Sri Lanka led to the wide use of asbestos related products. Though asbestos is not still banned in Sri Lanka it is nominated to be banned in 2018. Therefore proper elimination of asbestos containing materials after the usage is essential. Hence the development of environmental friendly, low cost and a simple method is very important to destruct the fibrous structure of asbestos.

In this study, Microwave radiation was used as an alternative energy source for traditional heat treatment methods. Its benefits include time savings, increased process yield and environment compatibility.

Initially the samples were studied after the conventional heat treatment, appropriate for the decomposition of fibrous structure of asbestos using SEM, IR and XRD methods. SEM images clearly show the transformation of asbestos fibrous form in to a powdered material after the decomposition. IR spectrum clearly shows the disappearance of the characteristic double peak at 3640-3680 cm^{-1} for asbestos fibrous structure. The disappearance of the characteristic peaks at 12° and 25° (2θ) in the XRD data confirms the damage of the fibrous structure.

Decomposition was observed SEM, IR and XRD for the samples treated thermally using microwave as an alternative energy source other than the conventional heat treatment methods. According to the structural and phase transformation of selected samples, microwave radiation can be recommend as an alternative energy source for traditional heat treatment methods use in the decomposition of asbestos. Further details will be discussed in this presentation.

Design and implementation of a multi element visible light bi-directional communication system

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Power Light Emitting Diodes (LED) exhibit high efficiency and high frequency capabilities. As such in addition to interior lighting systems, they can be used for communication purposes. In visible light communication (VLC) systems, data transmission is performed by modulating one or several LEDs according to data signal through a switching circuit. At the re receiver, light power received on a photo diode is demodulated to recover the data. Recently, VLC is used for indoor data communication, underwater communication, traffic control systems, and indoor positioning systems etc. Most important usage is using VLC for indoor data communication since it can achieve high data rates, less interference from other electromagnetic signals, energy efficiency, and high security.

However, implementing a VLC communication system has many challenges due to undesirable ambient light conditions and need of high speed electronics circuits. There are many research to solve such issues. Moreover, since practical communication systems require both downlink and uplink transmission, enabling bi-directional capability in VLC systems is important. Some research has presented bi-directional solutions using visible light for downlink and infrared for uplink transmission. In addition, to communicate data in a room such as between two access points, visible light can be efficiently used in both directions.

In this work, we have designed a VLC bi-directional communication system with 3 LED transmitters and a photodiode. By analyzing the mathematical models of LED and Photodiode, geometric design of the transceiver is introduced to reduce the self-interference of the bi-directional link. Using this method bi-directional VLC system can be identified as two separate links which has minimum self-interference. Pulse Position Modulation (PPM) is used in transmitter for dimming controlling of LED lighting. By changing and measuring the bit error rate, the optimum geometry for transceiver was determined. Varying ambient light condition affects the performance of VLC. By using moving average filter ambient light effect can be removed to a negligible level. Measurement results clearly show that our VLC system is capable of superior performance in addition to increasing the operating distance.

Engineering and Built Environment

Metals in old bridges in Sri Lanka – a review

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Metal bridges were introduced to Sri Lanka in the 19th century with the development of the road network and the railways. Most of these metal bridges are still in use. However, the collapse of several old iron and steel road bridges has been reported in the recent past highlighting the need for assessing these old bridges in the country. The usual assessment process of existing metal bridges needs a clear identification of metals used to build them and their mechanical properties. Material identification and the determination of mechanical properties of metals is usually done in laboratories. However, some of the tests such as fatigue testing and testing for the combined effects of fatigue and corrosion are expensive and time-consuming. Therefore, empirical and numerical methods are used to determine the material properties based on the results of simple and monotonic tests, such as, tensile and hardness tests.

Even though material properties are the most important data for assessing old structures, very few studies have been conducted with this regard. The present study consists of experiments, reviewing literature and applying empirical and numerical methods to identify typical properties of materials of old metal bridges in the country. This data can be used effectively in the assessment of existing old metal bridges in the country.

The study shows three types of metals used in old metal bridges: cast iron, wrought iron and steel. Cast iron was mostly used for bridge piers. Wrought iron was the common metal used for the superstructure at the beginning and was replaced by mild steel in the late 19th century. The present study proposes strength properties for old metal bridges. The typical ultimate tensile strengths of wrought iron and mild steel are between the ranges of 284 - 343 N/mm^2 and 372 – 450 N/mm^2 respectively. The yield strengths of wrought iron and mild steel are between the ranges of 191 – 241 N/mm^2 and 233 – 280 N/mm^2 respectively. The surface hardness of wrought iron and mild steel are between the ranges of 57 – 63 and 65 – 68 (Rockwell HRB) respectively. The fatigue strength at 10^7 cycles of wrought iron and mild steel are 160 – 165 N/mm^2 and 200 – 260 N/mm^2 respectively. The study also shows that the fatigue strength of wrought iron and mild steel can be predicted using empirical formulae: i.e. the rotary bending fatigue strengths of wrought iron and mild steel at 10^7 cycles are 0.47 times the ultimate tensile strength. However, the usual relationship between the ultimate tensile strength and Brinell hardness of wrought iron and mild steel was not observed in the test data.

Design of a DC MicroGrid for utilization of solar photovoltaic sources

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To satisfy the demand for electricity, renewable energy sources (RES) are being used at an increasing rate y. Though these sources are environmentally friendly, the addition of RES to the low voltage distribution network directly may create voltage and stability issues. MicroGrids are considered a promising solution that will help overcome these problems.

MicroGrid is a small power system which consists of a local energy source, storages and loads. Since MicroGrid has a utility connection, it can be in grid connected mode or islanded mode. If the plug and play capability within a MicroGrid can be realized, any source or storage can be connected or disconnected from the MicroGrid without making significant changes to the system. Therefore, MicroGrids unveil a platform to connect RES such as wind, solar photovoltaic (PV) etc., which has an energy output highly dependent on environmental conditions. In recent years researches were carried out on alternative current (ac) and direct current (dc) MicroGrids worldwide. As a result, the use of dc MicroGrids has increased rapidly; in solar PV systems dc is the natural power output and in wind power systems there is an intermediate dc power stage. In addition, the ac-dc converter in most existing loads can be eliminated in a dc system resulting in further reduction in losses.

In this study, a dc MicroGrid was designed with a utility connection, a solar PV and resistive loads. The proposed system was simulated in PSCAD/EMTDC software. A bi-directional ac-dc converter was designed to interface the utility with a dc-link of the dc MicroGrid. A uni-directional dc-dc converter was designed to interface the photovoltaic system to the dc-link. The controller of the ac-dc converter maintains the dc-link voltage of the MicroGrid constant while the photovoltaic system delivers available maximum power. The performance of the MicroGrid was studied by applying variations to the load and to the irradiance of the solar PV panel. The system dynamics of the MicroGrid were studied and presented. Further studies will be carried out to incorporate energy storages, to optimize the overall control process and to improve the protection of the dc MicroGrid.

Motion evaluation of particles in a multi-pass vibro-fluidized bed tea dryer

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Multi-pass vibro-fluidized bed dryer is a novel energy saving design concept. This single unit drying chamber has three sloping decks fixed vertically one over the other in a zigzag path. The docks slope in opposite directions to facilitate uniform particle motion. Each deck measures 3.6 m x 0.78 m and consists of perforated sheets having 13 holes per square centimeter of 1.5 m .The three deck units is made to vibrate horizontally at a 3 mm amplitude using an eccentric shaft driven by a 5 kW electric motor. A centrifugal fan (5 kW) with the capacity of 2.83 m^3/s is used to supply air for fluidization.

The scope of this study was limited to optimize the vibration frequency and slope of the deck to obtain the expected particle moving speed of 6 mm/s at different moisture contents (MC). Orthodox rolled tea dhools of three levels of moisture (10%, 30% and 55%) were used for testing at different vibration frequencies and slope of the deck at the fixed amplitude and air flow rate. The three moisture contents represented the expected mean moisture contents in the three decks.

All calculations were done by using a plot of speed, frequency and slope on Excel sheets. Results revealed that the moisture content influenced the particle motion speed on the bed. Decrease in moisture increased the particle speed at a given bed slope and frequency. The frequency of 38 Hz (504 rpm) was the best for the expected particle speed for all three moisture levels. The optimum bed slopes were determined as 3%, 4% and 5% for 10%, 30% and 55% MC (wet basis), respectively, at 38Hz (504 rpm).

Crop water requirements and irrigation scheduling:
Lower Uma Oya development area

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Water being a scarce resource and a commodity that has an exponential demand, it is important that the resource is used in the most efficient way. Uma Oya Multi-Purpose Development Project in which water is to be diverted from Uma Oya to Kirindi Oya while generating hydro-energy has been proposed to address this issue. As a part of the project, there is a proposal to enhance irrigation facilities in Kirindi Oya basin using the additional water received to the basin. This includes the construction of a new reservoir, raising an existing dam and the construction of many irrigation canals to provide water to existing as well as novel irrigation areas.

A study was carried out to propose an optimized cropping pattern for paddy cultivation, which minimizes crop water requirements within the proposed development area. This was done as such a crop water assessment has not been done in the area. To achieve this objective, the CROPWAT software, which is a computer model that estimates evapotranspiration, effective rainfall, crop water requirement and irrigation scheduling was used. Monthly meteorological data including maximum and minimum temperatures, rainfall, wind velocity, relative humidity and sunshine hours were collected during the period from 2000 - 2014 and were used as input data. Four scenarios were considered in the study; years with rainfalls of 20%, 50% and 80% probability of exceedance, representing a wet, normal and a dry year, respectively and an average year determined based on monthly values. The analysis was, initially carried out in the Yala season (March – May) and the Maha season (Sept –Jan). Then, the cropping calendar was shifted by two weeks forward and backward for the above scenarios and the results were calculated with the motive of identifying the cropping periods which give the minimum water requirements. The results indicated that the cropping calendar shifted forward in the Maha season and backward in the Yala season resulted in the minimum irrigation requirement. It also depicted that there was a 63% and a 26.5% difference in water requirements for the Yala and the Maha seasons, respectively, when the wet and dry years were compared for the selected cropping periods.

Hierarchical method to classify emotions in speech signals

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Automated speech emotion recognition is a crucial element in the computational study of human communication behaviors. This process supports human decision making and helps to design human-machine interfaces that facilitate efficient communication. In the designing phase, feature extraction, selection and classification methodology are major concerns. This study proposes a hierarchical approach for automated speech emotion recognition.

In this study, a publicly available German database (EMODB), which contains speech samples uttered in 7 different emotions, namely Anger, Boredom, Disgust, Fear, Happiness, Neutrality and Sadness was used. The hierarchical classification methodology proposed is based on Fisher Linear Discriminant Analysis (FLDA) and K Nearest Neighbour search (KNN) to classify the emotional states of speech. The hierarchy is mainly composed of three stages; in the first stage, angry speech signals are separated from others. Then, in the second stage   sad speech signals are extracted from the non-angry set obtained in the first stage. In the third stage, the rest of the speech signals are divided into two different clusters, one with neutral and boredom speech signals and the other with happy, disgust and fear speech signals in it.

In this scenario the same emotional impact is delivered through various speech patterns and through different people; hence, the degree of freedom is high. Thus, a simple standard classification method cannot be used. This makes the sparseness of the clusters complex. Further, the emotion classification is complicated when compared to the speaker or speech recognition, because some emotion specific hidden features are to be discovered independent of the speaker and the speech.

In many of the previous studies, a direct approach is used to classify emotions with large feature sets. In contrast, a hierarchical method is followed in this study to improve the recognition rates with a minimum number of features to make the system more efficient by saving computational cost. This method improves the recognition rates over the previous studies [1] by 9%, 3% and 8% on sad, neutral and bored emotions. As particular features help to distinguish some specific emotional content of the speech signal explicitly from other emotions, the hierarchical method becomes more effective.

Optimization of nearest neighbour selection using ROC for a KNN based classifier

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In cluster analysis, input data are grouped based on some inherent similarity measures. This is basically known as unsupervised learning. In the context of speech emotion recognition, many data clustering techniques have been introduced in previous studies. This study proposes a binary hierarchical classifier based on Fisher Linear Discriminant Analysis (FLDA) and K Nearest Neighbour search (KNN search). At each stage of the hierarchy, the training speech signal was mapped into a feature space and the clustering patterns were observed. Then, the test speech was categorized into an emotional cluster considering the maximum likelihood of nearest neighbours belonging to that cluster. At this point, the number of neighbours varied from stage to stage of the hierarchy, as some acoustic features are common to several emotions.

The selection of the optimum number of allowable nearest neighbours was done using Receiver Operating Characteristics (ROC) curve. As indicated in previous studies, a fixed number of allowable nearest neighbours have been used at each stage of the hierarchical method.

The optimum allowable number of neighbours differs from application to application according to the True Positive Rate (TPR) and the False Positive Rate (FPR) of the recognition. For example, in an emotion recognition system, where the proposed classifier has been applied, getting a higher false positive rate is problematic for surveillance and call center applications whereas in automatic translation systems, a bit higher FPR will not generate an adverse effect. Hence, the allowable number of neighbours will depend on the applications where the KNN classifier is used.

The ROC curve was used to justify the selection of the optimum number of allowable nearest neighbours.

Design of a boost converter for a DC grid powered by a photovoltaic panel

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Electricity generation through renewable energy sources has gained interest in countries around the globe as such sources are environmentally friendly. Photovoltaic systems are becoming a popular renewable energy source. The main issue with the PV system is the intermittent nature of the output power. In addition, such system will be connected in weak distribution systems, which introduce stability and protection issues to the utility network. MicroGrid is an attractive solution to overcome the above issues. MicroGrid is a small power system with local generation and local loads which can be operated autonomously or by grid connected nodes. DC MicroGrid reduces power conversion losses at the point of generation and loads.

This paper discusses the development of a DC MicroGrid with photovoltaic systems as the electricity generation method. This paper also presents the design and simulation of a boost converter for the DC MicroGrid. The operating voltage of DC loads is 48 V. Therefore, the DC grid voltage was selected as 48 V. The selected photovoltaic panel, Mitsubishi PV-UJ225GA6, produces 225 W and 30 V at the Maximum Power Point (MPP) under steady state conditions. Therefore, a boost converter is required to interface the photovoltaic panel to the DC grid. The control function of the boost converter is to ensure that the PV panel is operating at the MPP.

A 250 W, 30V-48V boost converter was designed and simulated in EMTDC/PSCAD software. Then, the small signal model around the operating point of the boost converter was derived. Using the model, a closed-loop controller was developed for the converter to control the average inductor current. The results of the converter under open-loop and closed-loop are presented in this paper. According to the results, it was possible for the converter to deliver the required power at 48 V output voltage and the controller was able to follow the command reference current.

Three port bi-directional DC to DC converter for electric vehicles

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Electric vehicles run by battery power face the problems of short range and battery degradation over time due to high charging and discharging current gradients. During the acceleration of the vehicle, sometimes the motor demands high power from the battery and during sudden braking, kinetic energy of the vehicle is converted to electrical energy and that power is returned to the battery. The major problem is that the battery performance gets severely degraded when exposed to such high charging and discharging current gradients. This paper proposes a new topology where it adds a super capacitor bank parallel to the battery to support catering high current gradients especially during peak power demands and to absorb as much energy as possible during braking without burdening the battery. Thereby it minimizes charging and discharging current gradients of the battery and hence, reduces its degradation.

The power electronic topology of the proposed system consists of bi-directional DC-DC converters between the battery and the DC link and between the super capacitor bank and the DC link. In addition, a three phase inverter sits in between the DC link and the motor of the electric vehicle. The two bi-directional DC-DC converters and the three phase inverter form the three port power electronic system. The battery provides the average power during the drive cycle while the above average power demand is supplied by the super capacitor during accelerations. When brakes are applied, the regenerative energy of the motor is captured by the super capacitor by utilizing its ability of fast dynamic response. At the point where the battery voltage is lower than a critical limit, the super capacitor is used as a source to charge the battery as well. The bi-directional DC-DC converter connected to the battery is in the current control mode and the bi-directional DC-DC converter connected to the super capacitor is in the voltage control mode. The designed topology is implemented in PSCAD and the simulations are carried out to study the feasibility of the approach.

Dynamic control design for five degrees of freedom robot manipulator

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In automated manufacturing lines or in any other application where Robot Manipulators (RM) are used, the high controlling ability of the RM is required for fast and accurate functioning. Nonlinearities in motors, drives, gears, friction between joints, weight distribution in robot arms, motor parameters, and many other facts make the task of controlling the RM a hard process. Basic controllers like P, PID, and many other controllers which give high controllability have been developed to overcome such complications. Basic controllers only use measured tracking error of the RM, but they do not offer high controllability because the mentioned nonlinearities caused by the dynamics of the RM are not considered. Hence, Dynamic Based Controllers (DBC) are used in robotics to achieve high controllability.

For an application like pick and place, average controllability over the robot's arms is enough. However, for applications like painting, welding or to handle tiny objects, smooth, fast and accurate functioning of the robot arm is mandatory. Hence, DBC can be used in such special purpose robots

This paper, presents a methodology for designing and implementing a DBC for an RM which can provide high controllability over large nonlinearities of the system. First, dimensional measurements of a system were taken and a CAD model of the system was implemented in Solid Works TM. It was then utilised to understand the workspace and system limitations. In order to design the DBC, a mathematical dynamic model of the RM is derived using the Euler-Lagrange equations. To get the overall dynamic model of the system, motor dynamics and RM dynamics are combined. Then, two inverse DBCs are designed with and without considering error dynamics. Next, those controllers are implemented and simulated in Simulink TM along with the mathematical model of the RM. From the simulations, it was observed that the error dynamics based approach delivers better results in reference tracking. However, both derived DBCs can compensate the dynamic behaviour when compared to the existing kinematic based controllers. With regard to the results, it can be suggested that a DBC is more suitable to overcome nonlinearities and for the proper functioning of the RM.

Near-real time vehicle diagnostic data collection and on-line vehicle monitoring system

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Recently, the number of vehicles running on roads has increased in manifolds resulting in increased traffic congestions on the roads and thus, wasting fuel and the time of passengers. It is a major contributor to environmental pollution and causes severe health hazards. Within this backdrop, this paper presents a development of a real time vehicle data collecting system and online monitoring system.

The On-Board Diagnostic (OBD) is a self-diagnostic and reporting capability introduced to the vehicles in 1968. The new OBD interfaces provide standardized real time communication between the OBD and diagnosing equipment. At present, the OBD has become the standard interface for all automobiles. However, OBD is used only for vehicle diagnostics during a repair and has no standard way to collect or store historical data except for a few proprietary solutions.

This system collects and transmits data in real time to a server. The system is connected to the OBD port through a commercially available OBD module using serial communication and AT commands (modem control commands start with "AT"). The module is connected to a smart phone via Bluetooth and the phone is connected to a web server via GSM communication. An android application developed for smart phone manages the data transfer between the OBD and the server.

The data stored in the server is visualized through a web application. It has several graphical modules to visualize the data as graphs, tables and route maps with idle points. These modules facilitate to interpret data to analyze individual trips, the bottlenecks of traffic, the idling time and fuel wastages. Using this information, the user can draw travel plans based on the previous routes and their traffic conditions at different times of a day. Also, these modules enable to get a better understanding of the performance of the engine and predict problems in advance.

This system would help drivers to be aware of fuel consumption, the driving behavior, traffic patterns and associated costs so that they can change their behavior to save fuel and time. Hence, this can be a potential future tool in creating fuel friendly driving patterns by recommending alternative mobility solutions thus reducing time and fuel wastage.

Biological pathways of nitric oxide production in anaerobic ammonia-oxidizing bacterial granules

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Nitric oxide (NO) is an important atmospheric trace gas, which has a direct effect on the ozone chemistry of the atmosphere. NO is a free radical and toxic to a wide range of organisms. Considering the toxicity of NO to humans, the Dutch government (MAC values, as of 1/1/2007) has defined the relatively low maximum 8-h exposure limit. Biological nitrogen removal from wastewaters via anaerobic ammonium oxidation (anammox) process is a sustainable treatment process due to its great advantages over the conventional methods and there are more than 120 full-scale treatment plants operated worldwide. According to some studies, 0.003-0.03%of nitrogen load is being removed as NO by an anammox process. In an anammox biofilm or granule, NO can be produced via mainly four microbiological pathways; namely i) anammox pathway by bacteria, ii) nitrification by Ammonia Odixing Bacteria (AOB), iii) nitrifier denitrification by AOB, and (iv) denitrification by heterotrophic denitriers. So far, no study has revealed the mechanism of NO emissions from anammox granules and it is still unclear which microorganisms and pathways are responsible for NO emissions in an anammox process.

Therefore, the study investigated the microorganisms and pathways responsible for the NO production in the anammox granules taken from an anammox reactor. Using anoxic batch experiments, anammox reaction and NO emission from anammox granules were estimated. The anammox and the NO emission rates were 0.41 ± 0.16 µmolmg-BSA–1 h–1 and 51.6 ± 11.9 nmol mg-BSA–1 h–1, respectively. Furthermore, the anoxic batch experiments using labeled isotopic substrates for microorganisms with or without inhibitors of microorganisms were conducted to identify NO production pathways. In inhibition batch tests, it was likely that both anammox and heterotrophic denitrifiers contributed in NO production in the anammox granules. To the best of our knowledge, this is the first report demonstrating the bacterial species responsible for NO emissions from anammox granules.

Development of low cost cathode material for electrochemical denitrification

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Nitrate is a well-known water pollutant which is responsible for many diseases. Long term consumption of nitrate rich water could lead to cancers in the digestive system. Due to this risk on human health, World Health Organization has imposed a maximum permissible level of nitrates in drinking water. Therefore, nitrates should be treated so that the nitrate limits will be below the permissible limits. Among the available nitrate removal technologies, electrochemical denitrification has drawn attention as an efficient, cost effective method with many other benefits. In electrochemical denitrification, electrode material plays an important role on efficiency and durability. Hence, many studies have been carried out to develop electrode materials, but most of those studies were limited to very expensive materials.

In this study, attention was paid on the development of a cathode material with low cost materials using electroless deposition techniques to plate Cu on Al and mild steel substrates. The substrate materials were shaped, cleaned and etched in preparation for plating. A plating bath consisting of EDTA and Cu^{2+} was prepared to plate Cu on selected substrate materials using HCOH as the reducing agent. Plating conditions such as Cu^{2+}, EDTA and HCOH concentrations, pH and the temperature of the plating solution varied during the plating process.

A successful coating of Cu was obtained only on Al substrate. The Al substrate was highly responsive for the changes of temperature and pH in the plating bath. The developed Al cathodes were characterized using cyclic voltammetry to compare the area which is actively participating in denitrification reaction. Then the surface morphology of developed cathodes were examined using Scanning Electron Microscope (SEM). SEM images showed that higher formaldehyde concentrations resulted in an increase of grain size of Cu deposit. The electroless plating rate observed to increase with the increase in HCOH concentration. The developed cathodes were used in denitrifying a synthetic solution, where almost all the cathodes succeeded in reducing the nitrate concentration from synthetic solution under controlled laboratory conditions than a pure Cu electrode. The highest nitrate removal rate which was 13.8% was observed in the plated electrode using 0.3M HCOH, where pure Cu electrode showed only a 1.8% removal rate. These results reflect that this setup could be further optimized to get better results.

Engineering and Built Environment

Diagnosability of hybrid systems using hybrid bond graphs

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If a system contains both discrete events and continuous parameters, it is called a hybrid system. Faults of such a system can be of three types; abrupt faults which are discrete, incipient faults which are small drifts of parameters and intermittent faults which may be corrected by small manipulation like a loose wire connection. In this research, the first two types of faults were considered and Hybrid Bond Graphs (HBGs) were used as the main modeling tool. HBG is a modeling tool which can model electric, mechanical, hydraulic, thermal or any kind of dynamic system.

Three simple electric circuits were modeled using HBGs and investigated for fault diagnosability of each circuit. First, state space equations were generated from HBG models and Global Analytical Redundancy Relationships (GARRs) were derived. For this, use two methods were used / can be used; covering path method or causality inversion. These were then used to obtain Fault Signature Matrix (FSM) for each circuit. Using the FSM, fault detectability and isolability of each fault was investigated. Finally, with the observations received from case studies, following necessary conditions were derived for a fault to be detectable and isolable. Control junctions model discrete events in the system. Modes of the system represent discrete states and therefore, by modeling the discrete behaviour of the system as a finite state machine, it is possible to diagnose discrete faults.

For any component connected to a junction to be detectable, there should be a sensor connected to that junction or to the junction just upstream of the power flow of the HBG. In such a junction, if only one component is connected, then a fault of that component is detectable and isolable but if there is more than one component connected, then they may be isolable as a fault class but not as individual faults. If two adjacent junctions do not have sensors, then it is not possible to generate GARRs and hence, detectability and isolability cannot be evaluated. Adding more sensors to the system will enhance fault detectability and isolability: the minimal necessary number in this case.

Abstract No: 426   *Engineering and Built Environment*

Investigation of mechanical properties of architectured materials

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The bottom up approach to make materials which will give desired properties became a major research area in chemistry and physics. The need to estimate / evaluate properties of such "architectured" materials arose in parallel. The engineers can give guidelines to the materials processing industry to produce materials with a certain internal geometry to give desired properties. The engineering mechanics along with homogenization technique is a very powerful tool used for this purpose.

We study various material structures in order to establish their mechanical behaviour under general loading (constitutive laws). Each new material must have its own constitutive relations and failure mechanisms in order for them to be used as a building block in engineering components. A unit cell and finite element model that has been developed for a metallic foam material to estimate its average apparent properties will be presented along with results from the finite element analysis.

It could be seen that the material shows microscopic non-linear behaviour from macroscopic strain less than 1%. The stress continues to increase during the non-linear deformation as well. The stress levels within the unit cell shows that only a narrow band of the ligament will yield even after large macroscopical strain. It has to be verified whether the macroscopical non linearity is due to the geometry of the cell structure, rather than the material yielding. A similar analysis can be done by loading the same unit cell in other directions and shear properties can be estimated.

The average apparent properties of the material can be calculated from this method with less computational cost or actual physical tests.
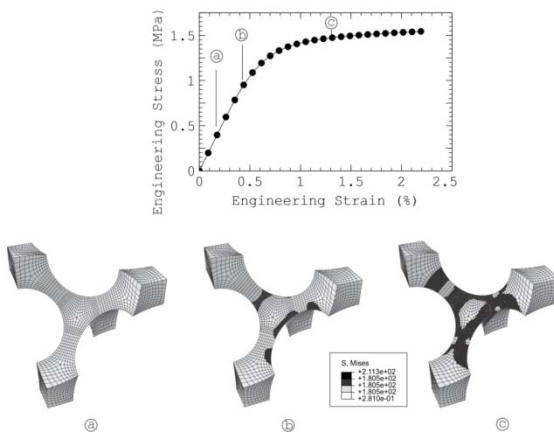
Photovoltaic powered led outdoor lighting system with battery storage

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Outdoor lighting is an essential item in the present lifestyle. Outdoor lighting is required during night time and it mainly depends on the utility supply. Lighting powered by a local power source reduces the burden on the utility network. Photovoltaic, coupled with battery storage is a possible solution. As Sri Lanka experiences a reasonable amount of solar power during daytime, this is an attractive solution and this has not been exploited well. This paper presents a photovoltaic powered LED lamp with battery storage.

The proposed system consists of a photovoltaic panel for power generation, battery storage for storing generated power from the photovoltaic panel and LED lamp to convert the electrical energy into light. The battery charges during daytime when sunlight is available through a buck converter. The controller of the buck converter consists of two loops: (a) inner loop, to control the input voltage and (b) outer loop, which is the maximum power point (MPP) tracker. The inner voltage controller is based on a PI controller. Fraction of open circuit voltage method is selected as the MPP tracker as its implementation is simple and follows the MPP with time. This controller ensures that the photovoltaic panel is operating at MPP.

The power rating of the LED lamp is 5 W. A 3.7 V lithium ion battery is selected for this application. Efficiency around 88%can be achieved when driving the LED lamp. A 5W photovoltaic panel is selected to charge the battery. On a good sunny day, it is possible to generate 11 Wh. Therefore, the capacity of the battery is 3000mAh at 3.7 V. The LED lamp is implemented and it provides the expected results considering the light intensity levels. The buck converter is designed and implemented. The open loop operation of the converter is verified. The inner current loop of the converter is designed. The maximum power pointer tracker is to be implemented. In conclusion, the proposed LED lamp powered by battery and photovoltaic panel is a relatively simple and environmental friendly solution for lighting applications such as corridors and small pathways.

Abstract No: 447   *Engineering and Built Environment*

Auto resonant wireless power transmission system

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In the 19th century, Nikola Tesla managed to transfer energy without wires over an air gap between two axially aligned coils using magnetic fields. This achievement marks the birth of the research and development of wireless energy transfer systems, a technology which has not seen a considerable growth during the last few decades though the researchers had their big eye on this topic.

In this project the technique of efficient WPT over short distance, using resonance inductive coupling has been researched. It will be widely useful in EV charging, aerospace and structural health monitoring. Further, this research is conducted to eliminate the drawbacks of existing wireless technology while introducing the auto resonance WPT as a solution. As the resonance conditions of the two coupled system can vary with the geometries of transmitters, environmental conditions and the distance between transmitter and the receiver. Auto resonance is a better solution for these deviations in real world applications.

Initially, the study on wireless energy transfer was conducted using resonance inductive coupling. The main steps carried out were implementing the resonance inductive coupling circuit, analyzing the circuit using different coil geometries, identifying the issues related to efficiency and frequency of WPT system and the solution to overcome the challenges in a practical environment.

The planar spiral and helix coil geometries were tested with the capacitor coupled resonance inductive coupling circuit and the circuits were analyzed with the power transmitting and receiving capabilities for different loads with the air gap between the transmitter and the receiver. In the practical implementations, remedies were taken to minimize the variations between the theoretical and practical system the issues related to transmitting power, frequency range and efficiency. The efficiency of the helix coil is higher than the planar spiral coil along the distance.

In the auto resonance system, the three resonant point indication methods are communication based indication, impedance based indication and variable capacitor based indication. The communication based indication was implemented by developing an algorithm to recognize the peak received power in kHz range (resolution up to two decimal points) and resonance frequency was found. This resonant frequency is chosen to transfer power in the available conditions. The communication is done through a different link until the resonant point of the system is verified. The theory based on impedance based method is, at the resonance point impedance of any system becomes real. Hence, phase shift between voltage and current waveforms is zero. This condition is checked using a phase lock loop circuit. Controller circuit is also used in the design. When the above conditions are satisfied, power is transmitted at the resonance. In the third method, the variable capacitor based indication; a variable capacitor at the receiver is adjusted according to the coupling with the transmitter. This method can be used to have multi receivers with a single transmitter. The capacitor changes it's capacitance to match with the resonance frequency. This method will be significant in most industrial applications.

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PAPER NOT PRESENTED

Enhancing the brass smelting process and indoor air quality of the traditional brass cottage industry

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The traditional brass industry is one of the oldest cottage industries in Sri Lanka. It has developed over the centuries undergoing various changes. However there is a significant gap in technology transfer in this industry when compared to the other cottage industries in Sri Lanka. Due to inefficient manufacturing practices, traditional brass craftsmen face severe problems at present. However, there are a number of simple modifications or redesigns which can improve the efficacy of manufacturing processes in this industry. One such application is redesigning of the furnace in order to enhance the thermal efficiency of brass melting process and thereby reducing the fuel cost. In addition to the current practices, much indoor air pollution takes place in these cottages which has led to some long term medical problems as well. Therefore, this research aims at addressing dual problems of the indoor air pollution issue and the inefficient melting process by introducing a new portable furnace design.

The furnace used at present is a fixed graphite-clay crucible with a clay wall. Heat is generated in the chamber by burning fuel oil. Brass is melted by absorbing that heat. According to calculations, this furnace has a very low efficiency of below 5%. As a result a large amount of heat is wasted making the production cost high. On the other hand carbon dioxide emission becomes high causing negative environmental impacts. Therefore, redesigning of an eco-furnace gives a number of benefits from all aspects.

The redesigning process of the furnace consists of a mathematical model and a 3D CAD model. By the mathematical model, the structure of the furnace was optimized. By comparing actual indicators and estimated indicators for thermal simulation of CAD model, performances were estimated. The minimum efficiency expectation is 9%. The expected annual electricity reduction is 9414.8 KWh/year. The estimated fuel reduction is 932.72 L/year. By this eco innovative design, there is a possible reduction of 30027.91 KgCO2eq/year in the Global Warming Potential (GWP) .The furnace will be fabricated using firebricks as a lightweight, portable furnace with a low cost. An advanced optimization will be done through continuous experiments by melting.

Engineering and Built Environment

Assessment of landscape aesthetics of southern expressway (E01 road), Sri Lanka

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The Southern Expressway is the first experience in Sri Lanka of an E01 class road. It has been constructed mainly considering engineering and traffic related requirements without paying much attention to the landscape-related issues. In addition, there are several proposed expressways to the country. Although the concept of expressways is new to Sri Lanka, many studies have already been carried out in developed countries on the built environment with a sound scientific background. However, there are no particular guidelines/manuals developed for landscape and aesthetics design for the roadside of the Southern Expressway in Sri Lanka. Hence, this research explores the necessity of the landscape aesthetics assessment and a better way to construct expressways while achieving optimum use of land and improvement of scenic quality.

Geographic information system and remote sensing were used to evaluate existing landscape land cover/use types and to identify environmental sensitive areas within 01 km buffer zone area along the expressway. The lush appearance of the buffer zone was evaluated by calculating the NDVI value, using "Landsat 8 imageries" and ERDAS imagine 2010 software. Initially, an attitude test was conducted to identify attitudes towards the existing landscape scenery and different landscape elements and to identify possible association between type of travel and attitudes. A visual preference survey was carried out based on the results of the attitude test. For that, nine photographs were selected after the field observation and models were developed using Real time Landscaping Architect® software, based on pre-determined different concepts.

Results revealed that the Southern Expressway is surrounded by different land cover/use types, environmental sensitive areas, archaeological reserves and ancient protected monuments, landslide prone areas, hydrological areas, forest and wild life reserves. The greenness varies throughout the buffer zone. The results of the survey carried out to test the preferences and attitudes show that there is not much attention/awareness among the users of the Expressway on scenic quality of the Southern Expressway and on different landscape elements. Significant associations ($p < 0.05$) were only shown between the type of travel and perception about evergreen plants. Results of the visual preference survey suggest the need of area-specific landscape designs and the importance of human perception-based methods in designing landscapes.

Investigation of barriers to implement sustainable manufacturing practices among traditional brass craftsmen in Sri Lanka

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The Sri Lankan traditional brass manufacturing industry has undergone considerable evolution in the past. Archaeological evidences like artifacts which belong to the Anuradhapura civilization to the Kandyan Kingdom witness the glory and popularity of the industry in the ancient era. Though modern technology has conquered many of the industries globally and locally after the Industrial Revolution and especially after Europeans invaded the island in the early 16th century, appropriate technology transfer has not reached the local brass manufacturing industry due to several reasons. Further, this industry faces severe problems such as scarcity and fluctuations of raw material prices, inability to obtain quality materials, improper practices and processes, inadequate marketing strategies etc. Technical needs of the industry have been assessed and steps have been taken to promote sustainable manufacturing practices in the recent past. However, still there is no proper study carried out on the barriers faced by craftsmen in order to adapt sustainable manufacturing practices in present context. A case study was carried out with several brass craftsmen who have already adapted some of the sustainable manufacturing practices promoted by previous studies. A feedback survey was then carried out to promote sustainable manufacturing practices among the traditional brass craftsmen after conducting workshops. The results of the case study and the feedback survey revealed that there are several socio-cultural and economic problems related to lack of interest on adapting sustainable manufacturing practices among traditional brass craftsmen.

Proximate analysis and determination of mineral, starch, ascorbic acid and cyanide contents in *Manihot esculenta* (CARI 555) grown in Sri Lanka

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Cassava, a popular local yam consumed in Sri Lanka, is an important source of energy and is a raw material for foods. A survey on cassava cultivation revealed that the most common cassava variety among local cassava cultivators is CARI 555 which is popularly known as "Alu Peradeniya".

This study was performed to determine the proximate composition, cyanide, mineral (K, Ca, Na and Fe), starch and ascorbic acid contents of the CARI 555 variety collected from local farmers in different areas of Sri Lanka. All proximate parameters and ascorbic acid content were determined according to AOAC standard methods. The cyanide content of starchy flesh was determined by a simple picrate paper kit method. Starch was extracted using the wet method.

Moisture content of cassava samples ranged from 59.9- 66.7% on wet basis. Ranges of protein, total fat, ash, fibre and carbohydrate contents were 2.0- 2.7%, 0.4- 0.6%, 1.7- 2.3%, 4.0- 5.0% and 23.4- 28.8% on dry basis, respectively. Concentrations of Na and K in the starchy flesh of CARI 555 were both significantly higher than that of outer and inner peel. The Na content ranged from 158.98 - 110.88 mg/kg and K content ranged from 55.90 - 40.32 mg/kg. Starchy flesh had a higher concentration of Fe when compared with the inner and outer peel (5.78 - 4.00 mg/kg). The starchy flesh of cassava tubers had the highest Ca concentration while inner and outer peel had lower values which ranged from 76.79 - 47.68 mg/kg. Results revealed that there was a significant variation in the mineral content of cassava depending on the region of cultivation. The starch content of the tuber ranged from 20.01- 22.40% while the ascorbic acid content ranged from 21.61 - 24.66 mg per 100 g of fresh tuber. The cyanide content of tubers ranged from 24.17 - 31.20 mg/kg while the lethal dose of cyanide is 0.5 -3.5 mg/kg of body weight. Therefore, it can be concluded that this variety of cassava is a good source of nutrition and its consumption should be promoted in Sri Lanka.

Analysis of genetic structure of non-descript local goat populations in Sri Lanka

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The knowledge on genetic structure of organisms is important not only to understand the evolutionary processes it has undergone but also to realize the role of environment on this process. Population genetics and phylogenetic studies are important to provide opinions on effective conservation and reintroduction plans especially when the target population is under threat of extinction. Sri Lankan non-descript local goats represent a threatened population due to indiscriminate slaughter and cross breeding practices. Population genetic structure of these animals is unknown other than the fact that they were introduced by Arabian sailors. Therefore, this study was devoted to evaluate genetic structure of local goats aiming to provide information for conservation programs.

The experiment was initiated with collection of blood samples from 61 goats in northern, northwestern, eastern and southern provinces of the country and DNA extraction from blood samples, polymerase chain reaction for exon 2-3 of alpha lactalbumin (LALBA) gene and DNA sequencing were performed subsequently. Phylogenetic trees were constructed utilizing Maximum Likelihood (ML) and Bayesian Inference (BI) methods in GARLI (v.96) and MrBayes (3.2.5.) software respectively. Parsimony networks were constructed in TCS (v1.2.1.). Within and among population genetic variabilities were calculated using AMOVA while pairwise mismatch distribution and selective neutrality were estimated in Arlequin 3.5.

Both ML and BI produced the same tree topology with little genetic structure and lower bootstrap branch support while the parsimony network consists of four main clusters which were not representing the sampling locality suggesting genetically likenesses. The idea is strongly supported by AMOVA test where within population variability is greater (98.74%) than among population (1.26%) (F_{st}=0.012, d.f=98, P=0.18) which may be attributed to cross breeding and transportation of animals. However, observed heterozygosity is still lower than the expected value ensuing, significantly negative results in neutrality tests; Fu's Fs (p<0/005) and Tajima's D (p<0.5). This can be resulted from a resent population expansion followed by a bottleneck event. Uni-model distribution of the mismatch profile also supports the idea of expansion of population size.

Results of this study reveal that local goat population is heterogeneous and contemporary population structure is highly influenced by anthropogenic activities. Therefore, immediate actions are recommended to conserve their genetic resources.

Abstract No: 260 (Poster)   *Food, Nutrition and Livestock*

Analysis of physicochemical properties of *Olu* (*Nymphaea pubescens* Willd.) seeds and production of *Olu* seed-incorporated snack bars

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This study was conducted to determine the physicochemical properties of olu (*Nymphaea* pubescens Willd.) seeds and to develop an olu seed snack bar incorporating sesame seeds and peanuts. Olu seeds, sesame seeds, peanuts and other ingredients were used for formulating this snack bar. The best of four formulations of olu snack bars was selected using sensory evaluation (hedonic test). Olu snack bars developed using the selected formula was subjected to a shelf-life study. Olu seeds had an arithmetic mean diameter of 0.15 ± 0.01 cm, geometric mean diameter of 0.18 ± 0.02 cm, a sphericity of 0.61 ± 0.01, a roundness ratio of 0.47 ± 0.06, and a roundness of 0.52 ± 0.01. Proximate analysis of olu seeds showed a composition comprising (dry basis) $81.24\pm0.16\%$ carbohydrate, $2.5\pm0.08\%$ crude protein, $0.65\pm0.03\%$ crude fat, $0.65\pm0.03\%$ crude fibre and $0.67\pm0.32\%$ ash. The moisture content of olu seeds were $14.31\pm0.22\%$. Solubility of olu seed flour at 30ºC and 100ºC were 1.24 ± 0.01 and 26.44 ± 0.59 %, respectively. The pH value, water holding capacity and water absorption index of olu seed flour were 6.4 ± 0.01, 1.39 ± 0.02 and 2.05 ± 0.08 g/g, respectively. Ni, Ca, Fe, Cu, and Zn contents were 0.07 ± 0.005, 18.89 ± 1.45, 1.06 ± 0.04, 0.069 ± 0.01, and 0.069 ± 0.01 mg/100g, respectively. Cd and Pb were not present at detectable levels in olu seeds. The four formulations of snack bars significantly differed ($P<0.05$) from each other in odour, texture, and overall acceptability but not in colour and sweetness. Based on these results, the formulation comprising 60% olu seeds, 5% sesame seeds and 15% peanuts was selected. Proximate composition (dry basis) of the olu snack bar was $59.89\pm0.11\%$, carbohydrate, $13.48\pm0.33\%$ protein, $12.53\pm0.69\%$ fat, $2.59\pm0.09\%$ ash while the moisture content was $11.33\pm0.2\%$. Levels of Ca, Fe, Cu, Zn and Mg were 71.08 ± 2.28, 1.611 ± 0.255, 0.158 ± 0.076, 0.788 ± 0.118, and 27.05 ± 0.57 mg/100g, respectively. The caloric value of the snack bar was 17.5 ± 0.12 kJ/g. Total plate counts, yeast and mould counts and coliform counts were less than the maximum acceptable limit and moisture content not significantly ($P>0.05$) different after one month of storage. Thus, there is a high potential to produce nutritionally rich olu snack bars with sesame seeds and peanuts which have acceptable sensory properties and shelf-life.

Abstract No: 263 (Poster)   *Food, Nutrition and Livestock*

Antioxidant properties of selected traditional rice varieties in Sri Lanka

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Rice is the major cereal crop as well as the main staple food in Sri Lanka and other regions of Asia. Previous studies on some of the traditional rice varieties of Sri Lanka (STRV) show higher nutritional value and bioactivity when compared with improved rice varieties cultivated in Sri Lanka. This study evaluates the antioxidant properties of extracts of selected STRV. Methanolic extracts of four STRV (Kalu Heenati, Pokkali, Kahawanu and Sudu Murunga) were used for *in vitro* antioxidant assays. Antioxidant properties of STRV were measured using total polyphenolic content (TPC), 1, 1- diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging, and 2-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid (ABTS) radical scavenging assays.

Methanolic extracts of selected rice varieties showed potent antioxidant activity. Mean TPC of STRV were in the range of $1.66 \pm 0.08 - 7.66 \pm 0.17$ mg gallic acid equivalents/g. Mean DPPH and ABTS antioxidant properties were in the ranges of $0.56 \pm 0.03 - 2.58 \pm 0.15$ and $3.83 \pm 1.08 - 13.14 \pm 0.90$ mmol Trolox equivalents/ 100g flour, respectively. The order of mean TPC in the rice varieties was Pokkali > Kalu Heenati > Kahawanu > Sudu Murunga. Results show a difference among rice varieties in scavenging activity for DPPH and ABTS radicals. The order of scavenging activity for DPPH radicals was Kalu Heenati > Pokkali > Kahawanu > Sudu Murunga while for ABTS radicals, the order was Pokkali > Kalu Heenati > Kahawanu > Sudu Murunga. Accordingly the antioxidant power of the extracts was in the order of Pokkali > Kalu Heenati > Kahawanu > Sudu Murunga. Rice varieties having red pericarps displayed higher antioxidant activities when compared to rice varieties having white pericarps.

The present study highlights the importance of STRV as potential sources of antioxidant compounds, especially the varieties of Pokkali and Kalu Heenati. These traditional rice varieties may be able to limit the risk of various chronic diseases associated with oxidative stress and this data will be useful to nutritionists for formulating therapeutic diets rich in antioxidants.

Development of avocado (*Persea americana*) incorporated butter

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The objective of the present study was to develop a butter incorporating avocado (*Persea americana*) pulp. Pre-treated avocado pulp (variety Fuerte) was mixed with raw cow milk and cream to prepare sweet cream butter samples and mixed with salt (1% w/w) and butylated hydroxyl toluene (BHT) 200 ppm. Five types of butter were prepared based on predetermined proportions. These were, T1(commercial butter): 100% cream and milk, T2: 25% avocado pulp + 75% cream and milk, T3: 30% avocado pulp + 70% cream and milk, T4: 35% avocado pulp + 65% cream and milk and T5: 40% avocado pulp + 60% cream and milk. Hundred millilitres of milk (100 mL) was included in all the treatments. Proximate composition of avocado pulp, physicochemical and microbiological tests of the developed avocado-incorporated butter were determined and compared with conventional butter. The fat content of butter was analysed according to the method described by Analysis of foods (I.S.3507, 1966). Free fatty acid (FFA) values were measured using the IUPAC method. Hardness (texture analyser model 4465, Universal testing systems, Canton, USA), and contents of Cu, Fe (atomic absorption spectroscopy) were measured in the developed butter samples. Sensory analysis was conducted using preference tests based on colour, aroma, flavour, spreadability, mouth feel and overall acceptability of butter using untrained panellists (n = 50). Avocado-incorporated butter showed a significant (P < 0.05) improvement in unsaturated fatty acid composition and mineral content (Cu, Fe) with increment of avocado pulp content from 25 to 40%. There was no significant (P < 0.05) difference in microbiological quality among the treatments. Hardness of avocado-incorporated butter was gradually decreased with increment of avocado pulp content from 25 to 40%. According to the sensory analysis, there was a significant (P < 0.05) difference in colour, flavour, spreadability, mouth feel and overall acceptability in avocado-incorporated butter (T4) but not in aroma. In conclusion, the present study revealed that incorporation of avocado pulp (25%, 30%, 35% and 40%) in butter has significantly improved the sensory and physicochemical properties of butter when compared with conventional butter.

Detection of methicillin-resistant *Staphylococcus aureus* in pig farms, farm employees and the farm environment in selected areas of Sri Lanka

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Methicillin-resistant *Staphylococcus aureus* (MRSA) is a common multidrug resistant bacterium, traditionally known as a nosocomial pathogen worldwide. More recently, a specific type of MRSA that emerged in livestock was denoted as livestock-associated MRSA (LA-MRSA). Potential transmission of LA-MRSA from animals to humans, particularly in association with pig farms, has been reported elsewhere. Due to its zoonotic nature, this organism poses an occupational health risk to the farming community, veterinarians, and field staff. Although it is of serious concern, there are no available records on occurrence of MRSA in livestock in Sri Lanka. Hence, the aims of this study were to investigate MRSA colonisation in pigs, employees of the pig farms and the farm environment in selected areas of the country.

From January-December 2015, samples were collected from 100 pig farms situated in five districts; namely, Puttalam, Kurunegala, Gampaha, Colombo and Kalutara. Pigs, pig pens, farm employees and their family members from each farm were sampled with the informed consent of the farm owner. Nasal swabs were collected from 493 pigs and 228 humans. The number of dust samples collected was 119. Samples were enriched in Mueller Hinton broth with NaCl and after overnight incubation, were plated on ORSAB (Oxacillin Resistance Screening Agar Base). Isolates were identified as *Staphylococcus aureus* by using routine microbiological investigations. The *mecA* gene was detected using a standard PCR to test for methicillin resistance.

Out of the 840 samples collected, 12 were positive for MRSA. The prevalence of MRSA colonisation in farms was 10% (10/100), whereas the prevalence in pigs was 1% (6/493). The prevalence in farm employees was 2% (5/228). One farm yielded MRSA in both animals and dust indicating possible environmental contamination. However, the prevalence identified in pigs in the present study is relatively low compared to literature from other countries. Sequence typing is being carried out in order to identify the presence of LA-MRSA among the isolates and to ascertain transmission between pigs and humans. In conclusion, this study indicates the presence of MRSA in pigs, farm workers and the farm environment in Sri Lanka.

Photocatalytic activity of TiO$_2$ reduces microbial contamination of the bovine udder and milking utensils

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Most microorganisms present on the surface of the bovine udder and milking utensils affect both udder health and milk quality. The main purpose of this study was to introduce a non-invasive and low-cost method to reduce microbial contamination on the surface of the bovine udder, in milking utensils, on the hands of milkers, and in milk itself.

We used 100 ppm platinum-doped anatase TiO$_2$ coated, 15,000 lux light emitting diode (LED) illumination lamps and a 30 W compact fluorescent light (CFL) bulb. Areas of 1 cm^2 were selected and marked using cardboard frames on the surface of the udder, hands of milkers and on milking utensils. These areas were exposed to LED illumination lamps for a period of one hour. During this time, microorganisms present would have been exposed to a cloud of activated TiO$_2$. Swabs were taken before and after exposure for microbiological analysis. Milk was exposed to TiO$_2$ by culturing on agar for three hours and then immersing the TiO$_2$-coated CFL bulb into the milk for four hours. All microbiological analyses were performed according to standard methods.

Microbial counts were significantly reduced on the surface of the udder by 30% from 3.52 ± 0.007 to 2.45 ± 0.113 log CFU/ cm^2; on the hands of milkers by 41%, from 3.58 ± 0.035 to 2.11 ± 0.160 log CFU/ cm^2; and on milking utensils by 21%, from 3.80 ± 0.034 to 3.01 ± 0.096 log CFU/ cm^2 after 1h of treatment. However, microbial counts in milk were only reduced by < 5% by the method followed. This could be due to interference of milk fat.

These results support the conclusion that it is possible to use the photocatalytic activity of TiO$_2$ to reduce the microbial count on the surface of the bovine udder, hands of milkers and on milking utensils. The efficiency of the method may be increased by using a higher concentration of TiO$_2$ and a higher-intensity CFL bulb.

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Wood apple (*Feronia limonia*) pulp incorporated whey beverage as a method to utilise whey in natural form

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Whey is a by-product of cheese production and although it has high quality nutrients, it is not efficiently utilised in Sri Lanka. Whey contains proteins (0.8%), lactose (4.5%), fat (0.2%), minerals (Ca, Mg, P, K and Na) and vitamins (B_2, B_6, and C). However, utilization of cheese whey in its natural form is limited due to its peculiar flavour and taste produced as result of starter cultures and enzymes used in the process of manufacturing cheese. Therefore, the focus of this study was to develop a method for efficient utilization of cheese whey in its natural form as a value-added dairy by-product. Wood apple (*Feronia limonia*) is a tropical fruit with a high protein content (7.1%) and low levels of fats (3.7%) and carbohydrates (18.1%). It is rich in β-carotene, vitamins B and C, oxalic, malic, citric and tannic acids.

Wood apple pulp extract was incorporated into cheese whey to enhance the palatability and nutritional value of whey and to mask the flavour of whey. After a series of preliminary trials, three different ratios (by volume) of wood apple extracts (15%, 25% and 35%) and pasteurized whey (85%, 75% and 65%) were mixed together. Sugar and carrageenan (E-407) were used to enhance the mouth-feel and stability. Finally, physicochemical parameters (pH and titratable acidity) and microbial activity were assessed during storage under refrigeration for 10 days.

Results of sensory analyses revealed that the best ratio of wood apple extract to whey is 35% to 65%. Proximate composition analysis showed that the final product contains 18.8% total solids, 0.62% protein and 2.05% fat. The energy content of the final beverage was 331.31 Kcal/kg. Analysis of chemical parameters revealed that the pH decreased from 4.3 to 3.4 and titratable acidity increased from 0.68% to 0.76% during the storage period. Furthermore, there was a slight increase in the total plate counts during storage although there was no yeast and mould growth during this period. It may be advisable to heat treat the final mixture to increase food safety.

Water footprints of Friesian and Jersey cattle under intensive farming conditions in a mid-country farm, Sri Lanka

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The water footprint defines the amount of water that is used along the production chain of a particular commodity. Commodities of animal origin are considered to have high water footprints compared to their crop counterparts. A study was conducted to estimate the water footprints of Friesian and Jersey cattle breeds under intensively managed mid-country farm conditions. Six dairy cows in similar physiological status (Friesian 350-435 kg body weight, with milk yield of 6-12 L/ day; Jersey 250-300 kg body weight with milk yield of 5-8 L/ day, and all cows in their 4-5 lactation) were selected representing the two breeds (n=3 each). Total consumptive water requirements were quantified under four categories, namely: water used for drinking water, service water, water in roughage feed and water in concentrate feed over 30 days of the experimental period. The water footprints of Friesian and Jersey breeds were calculated on the basis of body weight and milk yield of each experimental animal. The average estimates of water footprints for Friesian and Jersey breeds were 0.0472 m^3kg^{-1} and 0.0629 m^3kg^{-1}, respectively on the basis of body weight, and 2.512 m^3L^{-1} and 3.004 m^3L^{-1}, respectively on the basis of milk yield. The findings also indicated that although a large proportion of the feed for cattle in the farm is borne by roughage, 88% of the total consumptive water in both breeds was contributed by indirect water in concentrate feed. The estimates for individual animals showed that there was a variation of water footprints among individuals according to their production status. However, there was no significant difference (P> 0.05) of consumptive water requirement on the basis of body weight or milk yield between the two cattle breeds. Results of the present study provide estimates of water footprints for two dairy breeds commonly managed under intensive farming conditions in Sri Lanka. Further, this preliminary investigation reveals that there is no difference in the water footprint between Friesian and Jersey cattle breeds under the production conditions prevailing in an intensively managed mid-country farm.

Compositional analysis of tropical almond (*Terminalia catappa* L.) and development of a non-dairy milk product

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Tropical almond (*Terminalia catappa* L.), locally known as *kottamba*, is a multipurpose species and *kottamba* kernels have nutritional properties which confer health benefits. This study was conducted to determine the nutritional composition of *kottamba* kernels and to develop a non-dairy milk from *kottamba* kernels. Presently, the consumer demand for plant-based milk products is increasing as a healthier alternative to dairy products, especially among lactose-intolerant consumers.

Physical properties of the fruit, proximate composition and mineral contents in *kottamba* kernels were determined. *Kottamba* kernel milk was extracted by blending kernels that were soaked overnight and blanched (water: kernels ratio 2:1) and the resulting liquid fraction was separated for analysis. However, this soaking step caused some negative impacts on the physical, sensory and nutritional properties of the kernel milk. Pasteurised and sterilised *kottamba* milk products were developed and subjected to sensory analysis and a storage study.

The moisture content of kernels was $5.35 \pm 0.29\%$. The proximate composition (in % dry basis) of *kottamba* kernels was crude fat 50.09 ± 0.15, crude protein 32.30 ± 1.10, carbohydrate 5.13 ± 0.84, crude fibre 1.81 ± 0.21 and ash 5.31 ± 0.24. Mineral contents ($\mu g/g$) in the kernel were P 2200 ± 1.22, Mg 400 ± 2.01, Ca 320 ± 1.67, Cu 81 ± 1.36, Fe 58 ± 1.33 and Na 13.61 ± 1.82. Bottled *kottamba* kernel milk with 3% sugar was preferred over 6% and 9% sugar according to the sensory analysis based on a ranking test ($P < 0.05$). The shelf life of pasteurised and sterilised bottled *kottamba* kernel milk was 2 and 4 weeks respectively. Fat (7.78%), protein (6.46%), carbohydrates (8.03%) and minerals (P, Mg and Fe) in *kottamba* kernel milk were significantly higher than in dairy milk ($P < 0.05$). Xanthan and guar gums at a 1:1 ratio was the best combination of stabilisers with the lowest creaming index value in the commercial beverage due to their synergistic effect. In conclusion, *kottamba* kernels are rich in nutritional value and possess a high potential for production of non-dairy milk at a commercial scale.

Antioxidant activity and cyanide content of leaves of three different cassava varieties (*Manihot esculenta* Crantz)

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Cassava leaves are commonly used as a vegetable among rural communities in Sri Lanka. They are nutritional as they contain different proteins, amino acids and vitamins as well as fibres. The aim of this study was to determine the antioxidant capacities and cyanide contents of three different varieties of cassava (MU-51, CARI 555 and KIRIKAWADI). Fresh cassava leaves were collected from the Department of Horticulture, Gannoruwa. Methanol extracts of air dried leaves were used for determination of antioxidant capacity using the 1, 1-diphenyl-2-picrylhydrazil (DPPH) assay. Ascorbic acid was used as the standard. The radical scavenging capacity of DPPH was expressed as the concentration of the sample which showed 50% radical scavenging capacity (IC_{50}).

Fresh leaves were used to determine the cyanide content. Leaves were distilled in 0.5% phosphoric acid and the distillate was titrated against silver nitrate.

For DPPH, the IC_{50} values of methanol extracts of leaves of MU-51, KIRIKAWADI and CARI 555 were 40 ± 2.23, 47 ± 2.05 and 50 ± 1.78 mg/l, respectively. Ascorbic acid gave an IC_{50} value of 5.4 ± 1.28 mg/l. Therefore, the antioxidant capacities of methanol extracts of these three cassava varieties were about10-fold lower than that of ascorbic acid. The cyanide contents of the three varieties of cassava were approximately similar with KIRIKAWADI, CARI 555 and MU-51 having cyanide concentrations of 48.6 ± 5.4, 46.76 ± 6.23 and 44.93 ± 7.23 mg/Kg, respectively. The acute lethal dose of hydrogen cyanide for humans is reported to be 0.5 - 3.5 mg/Kg body weight. Therefore, a large variation in the lethal dose, ranging from 30 - 210 mg of HCN for a 60 Kg adult, has been reported. According to this study, approximately 45 mg of cyanide is present in 1 Kg of fresh cassava which will not be at toxic levels for humans.

Potential of palmyrah (*Borassus flabellifer*) leaf powder as ruminant feed and its chemical and physicochemical properties

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Palmyrah (*Borassus flabellifer*) leaves are utilised as a supplementary animal feed in the Northern and Eastern provinces of Sri Lanka due to its nutritional value and availability throughout the year. However, palmyrah leaves are currently not utilised as storable animal feed, nor have there been any studies to determine the potential of using palmyrah leaf powder as animal feed. The objectives of this study were to determine the nutritional value and physicochemical properties of palmyrah leaf powder and to explore the potential of using powdered palmyrah leaves as an animal feed. Sundried, chopped and ground palmyrah leaves were sieved through a mesh (no 18) and the chemical composition and physicochemical properties of this powder were analysed using standard methods. Further, the economic viability of using this powder as ruminant feed was also assessed. The nutrient composition of palmyrah leaf powder was as follows (w/w percentages): crude protein 10.84 ± 0.45, ether extract 5.36 ± 0.08 g and ash 7.04 g ± 0.26. The energy content of the powder was 17.65 KJ and it contained 7.47 ± 0.12 w/w % of moisture. Physicochemical properties of the powder are as follows; pH 5.67 ± 0.01, total soluble solids 1.62 ± 0.01 Brix, inverted sugar 1.64 ± 0.01, bulk densities 36.22 ± 2.75 g/cm3, water holding capacity 2.76 ± 0.06 g/1g dry sample, oil holding capacity 1.97 ± 0.08 g/1g dry sample and swelling capacity 61.66%. These results show that palmyrah leaf powder has potential as a feed resource and can be used to feed ruminants especially in the Jaffna peninsula.

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Optimization of reaction parameters for production of structured lipid from coconut (*Cocos nucifera*) and sesame (*Sesamum indicum*) oils using Response Surface Methodology (RSM)

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Structured lipids are triacylglycerols (TAG) that are restructured or modified to change the fatty acid composition and/ or their positional distribution in glycerol molecules. Structured lipids are produced by interesterification to have the desired fatty acid composition for improved nutritional or functional properties. The effect of certain reaction parameters (temperature, time and weight ratio of oils) on enzymatic inter-esterification of coconut (*Cocos nucifera*) oil (CO) and sesame (*Sesamum indicum*) oil (SO) was studied using response surface methodology (RSM). Aqueous lipase derived from *Rhizomucor miehei,* diluted in phosphate buffer (pH 8) was used at 0.2% (v/w) of the substrate. A three-factor and three-level face-centred cube design with 20 runs was employed to optimise the following reaction parameters: temperature (45-65°C), time (16-48 h) and weight ratio of oils (CO:SO; 70:30 to 50:50). The degree of inter-esterification (DI) and the ratio of monounsaturated and polyunsaturated fatty acids (MUFA:PUFA) were used as response variables. TAG fractions were separated using thin layer chromatography (TLC) and fatty acid composition of the TAGs was determined using gas liquid chromatography (GLC).

The linear effects of all three factors were significant for the DI which ranged from 9.12 ± 1.63 to 26.31 ± 1.78 while the MUFA:PUFA ratio ranged from 1.24 ± 0.01 to 1.66 ± 0.07. The linear effect of oil ratio and interaction effect of time and oil ratio too showed significant effects. A temperature of 57.12°C, time of 16 h and a 50:50 weight ratio of oil (CO:SO) were found to be the optimum conditions. According to the response surface regression analysis, R^2 value for DI and MUFA:PUFA ratio were 0.80 and 0.82, respectively. Models fitted for both DI and MUFA:PUFA ratio were significant with non-significant lack of fit. Therefore, the constructed models and data provide useful information to scale up the production of structured lipids from inter-esterification of CO and SO. The novel lipid produced contains beneficial fatty acids from both coconut and sesame, namely, medium chain fatty acids from coconut oil and MUFA and PUFA from sesame oil which could possibly be used in the production of healthy fat-based products.

Impact of water added to seeds and the speed of shaft rotation upon the yield and temperature of sesame oil extracted in a domestic screw expeller

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Sesame seeds used for oil extraction in Sri Lanka are solar-dried under direct sun to equilibrium moisture content (MC). At the commencement of oil extraction a certain amount of water is sprinkled onto the seeds. In this study, the combined impact of water added to solar-dried seeds and rotational speed of the screw shaft of a domestic screw-type oil expeller (DL-ZYJ02, Dulong, China) upon the yield and the temperature of sesame oil being extracted was investigated.

Sesame oil was extracted from washed, solar-dried, whole, commercial white sesame seeds using a domestic oil expeller. The rotational speed of the shaft was varied by varying the machine frequency to 30, 40 and 50 Hz. Water contents of seeds used were as follows: wet seeds solar-dried to 4.5%db (dry basis) MC; seeds with equivalent 7.0%db MC prepared by sprinkling water on 4.5%db MC seeds two minutes before oil extraction followed by thorough mixing of water with seeds; seeds with equivalent 9.5%db MC prepared by sprinkling water on 4.5%db MC seeds 24 hours before the commencement of oil extraction followed by thorough mixing, refrigerating and thawing during the last hour. A full factorial experimental design was carried out in triplicate and results were analysed by studying main and interaction effects.

A significant reduction in oil yield was observed with increase of added water whereas machine frequency had an insignificant impact upon the yield. A lower machine frequency resulted in longer residence time and lower equivalent seed water content. The resultant relative absence of water to absorb frictional heat produced caused higher temperatures of oil being extracted.

To produce cold pressed sesame oil (below 50°C) using this domestic oil expeller, we recommend the following: sesame seeds with 4.5%db inherent moisture content be used; 23.5 g of water per kg of seeds be sprinkled on the seeds just before commencement of oil extraction; and the expeller be rotated at 40 Hz frequency. This combination resulted in 45.2±0.1% oil yield and 48.1±1.6°C oil temperature. Other oil extraction machines could also be optimised for cold-pressed oil production using a procedure similar to the one outlined in this study.

Prevalence of lice infestation in village chicken reared in the Vavuniya veterinary range

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Lice infestation causes production losses in village chicken reared in many tropical countries. Despite this fact, information on lice infestation in village chicken in Sri Lanka is scant. Therefore, this cross sectional study was performed to estimate the prevalence of lice infestation in village chicken in the Vavuniya veterinary range.

A total of 335 village chickens from 105 households were carefully examined for lice infestation using a hand lens. Representative samples of lice were collected from each positive bird and fixed in 70% ethanol containing 10% glycerol and identified by morphological features. At the time of sampling, the sex, age, colour (dark or light), body weight and phenotype (feathered neck or naked neck) of each sampled bird was also recorded. A Chi-square test was used to analyse the data and a P value less than 0.05 was considered statistically significant.

Of the 335 birds examined, 201 (60%) were positive for one or more species of lice. Six species of lice were identified based on light microscopic morphology, namely *Lipeurus caponis* (40.9%)*, Lipeurus tropicalis* (34.9%), *Menopon gallinae* (28.7%), *Goniodes dissimilis* (17.9%), *Goniocotes gallinae* (10.8%) and *Menacanthus pallidulus* (1.2%). The prevalence of lice infestation was significantly higher (χ^2=28.308, $P < 0.0001$) in birds over 12 months of age (65.9%) compared to those less than 12 months of age (26%). Similarly, birds with a body weight greater than 1.5 kg had higher prevalence (63.6%) compared to birds less than 1.5 kg body weight (51%; χ^2=4.499, $P = 0.034$). There were no statistical differences in the prevalence of lice between male (60%) and female birds (64%; χ^2=0.441, $P = 0.507$); chicken with naked neck (60.7%) and feathered neck (59.9%; χ^2=0.013, $P = 0.908$); and dark (61.3%) and light coloured birds (56.8%; χ^2=0.551, $P = 0.458$). This study indicates that lice infestation is widespread in village chicken reared in the Vavuniya veterinary range and further work is necessary to determine the economic significance of this condition in the study area.

Consistency of the quality of palmyrah jaggery produced from palmyrah treacle during off season at a production facility in Jaffna

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Palmyrah (*Borassusflabellifer*) jaggery production from fresh sweet sap is seasonal (February to July). During off season, jaggery is produced from stored treacle which was produced from sweet sap collected during the previous season. In this study, we examined quality of 30 jaggery samples from randomly selected batches made from stored treacle at a community-scale production facility in Jaffna.

Sri Lankan standards (SLS) for Jaggery stipulate the following limits for quality jaggery: moisture<10%; total sugar>70%; reducing sugar<13%; ash<3.5%. Estimated means of jaggery samples were 4.6±0.7%, 87.4±2.9%, 8.5±0.5% and 1.7±0.2%, respectively. Respective coefficient of variations (CVs) were 15%, 3%, 6% and 12%. Attained crude protein content was 0.74±0.04% (CV=5%). Anderson-Darling (AD) test statistics for moisture (p=0.11), total sugar (p=0.11), reducing sugar (p=0.30) and protein (p=0.42) contents did not reject the null hypothesis that the sample considered comes from normally distributed population. AD statistic for ash content (p<0.05) rejected the null of normal distribution.

Means of calcium, sodium, potassium and phosphorus were 0.14±0.11%, 0.39±0.04%, 0.86±0.07% and 0.09±0.01%, respectively, which did not differ appreciably from literature values. Corresponding CVs spanned the range of 7 to 9%. AD statistics confirmed normal distributions for all minerals except for potassium (p<0.05). Means of pH and Brix value were 5.3±0.1 (CV=2%) and 19.5±1.0 (CV=5%). Estimated pH values showed a normal distribution (p=0.605) whereas Brix values did not (p<0.05).

We therefore concluded that moisture, ash, total sugar and reducing sugar contents of palmyrah jaggery samples tested confirmed well with the SLS for Jaggery. AD statistics led to the generalization of the above conclusion to the population of jaggery made during off-season at the said facility, except for ash content which was expected owing to the ad-hoc addition of low quality (40-50% purity) quicklime to sweet sap used for treacle and/or jaggery productions. The narrow range spanned by pH signified effective deliming during processing of every batch. High values of CVs of moisture content and ash content and the non-normal distribution of ash content and Brix value call for tighter controls during jaggery processing to further enhance the consistency of the quality of jaggery produced at the production facility targeting international market.

Identification of possible contamination points in small- scale yoghurt processing plants in Kandy district

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Yoghurt is a popular fermented milk product in Sri Lanka manufactured by small-scale as well as large-scale producers and often reaches the retail market without quality certification. Previous studies have identified low-quality yoghurts in the local market that were produced by small-scale processors. Therefore, the objective of this study was to identify possible contamination points along the yoghurt manufacturing process.

Nine small-scale processors from the Kandy District were selected and critical contamination points of their production lines were identified using microbiological analysis. Three production lines were tested in each processor from March 2014 to May 2016. Samples were collected from four pre-identified points in the process: namely, raw milk (n=27), boiled milk (n=27), milk after inoculation of the starter culture (n=27) and the final products (n=98). Samples were tested for Total Bacterial Count (TBC), presence of *Escherichia coli* (*E. coli*), yeasts and moulds according to procedures from Sri Lanka Standard Institution (SLSI). Data were interpreted based on SLSI standards for yoghurt and EU standards for raw milk.

Detailed analysis of production lines enabled identification of common contamination points. On the basis of EU standards, 66.6% of raw milk samples were microbiologically poor in quality due to high TBC ($>10^5$ CFU/ ml). *E. coli* were detected in 74.1% of raw milk samples. Of the boiled milk samples, 96.3% were microbiologically safe revealing that majority of the processors followed effective heat treatment irrespective of raw milk quality.

Of the 27 production lines, 13 batches had yoghurt of unacceptable quality due to presence of *E. coli*, yeasts and moulds. Of these, nine batches were unacceptable due to one of the above parameters and only one batch did not satisfy all three quality parameters. Since boiling was an effective method of making raw milk safe, post-heat treatment contamination could be the reason for poor quality of yoghurt in the above 13 batches.

The majority of processing operations produced microbiologically-safe yoghurt as 14 batches complied with SLSI standards. It may be possible to increase this number by education of small-scale dairy processors on the importance of hygienic production concerning both public health and economic aspects.

Effect of some plant extracts in reducing autoxidation of selected edible oils during storage

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There is growing interest in using antioxidants from natural sources to mitigate oxidative deterioration in food systems during processing and storage. Extracts of many plant materials have been reported to have varying degrees of antioxidant activities in fat and oils. The present study was carried out to evaluate the anti-oxidative effects of natural extracts from rosemary, oregano and pomegranate peel powder for stabilising virgin coconut oil (VCO), sesame oil (SSO) and sunflower oil (SO) during accelerated storage.

Oil samples containing extracts at 2% (w/w) were stored in an oven at 60ºC. Samples were drawn out on days 0, 1, 3, 5, 7, 14, 21 and 28, flushed with nitrogen and stored at -18ºC until analysis. Oil devoid of any extract was used as the control for each oil system. The level of oxidation was assessed by measuring peroxide value (PV) and thiobarbituric acid reactive substances (TBARS).

Results revealed that both PV and TBARS values gradually increased with storage in all oils indicating a gradual oxidation of oils with time. A significant ($P < 0.05$) inhibition of oxidation as a result of incorporation of additives was observed in all oils. The stability of oils increased in the order: sunflower oil < sesame oil < virgin coconut oil. Generation of primary as well as secondary oxidative products was higher in sunflower oil (PV: 1.33 - 5.38 meq/kg, TBARS: 68.27 - 104.12 meq MA/kg) than in SSO and VCO. The inhibition exerted by anti-oxidative extracts against development of primary oxidative products as measured by PV was significantly ($P < 0.05$) higher in SO followed by VCO and SSO. The inhibition exerted against development of TBARS was higher in VCO as compared to SO and SSO. It can be concluded that anti-oxidative extracts, namely pomegranate peel powder, oregano and rosemary, can be effectively used to mitigate auto-oxidation of edible oils during accelerated storage.

Effect of some plant extracts in reducing oxidation of selected edible oils during deep frying

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The repeated use of edible oils leads to oxidative degradation of lipids which results in the development of objectionable odours, flavours, colours and more importantly, generates toxicants. The objective of the present study was to examine the efficacy of natural anti-oxidative extracts obtained from rosemary, oregano and pomegranate peel in mitigating the oxidation of coconut oil (CO), virgin coconut oil (VCO) and sunflower oil (SO). These edible oils were used for frying standard-sized potato strips in the presence of three different anti-oxidative extracts; namely, pomegranate peel powder, oregano and rosemary extracts, at 2% (w/w) level. A sample of oil (10 mL) was collected into a vial, flushed with nitrogen and stored at -18°C until analysis. Frying was repeated twice more with the same oil. Oil devoid of any extract was used as the control. The samples collected were analysed for peroxide value (PV) and thiobarbituric acid reactive substances (TBARS). Results revealed that both PV and TBARS values gradually increased with the frying cycle in all oil systems tested, indicating a gradual oxidation of oils with time. A significant ($P < 0.05$) inhibition of oxidation due to incorporation of additives was observed in all oil systems. A significantly ($P < 0.05$) high level of oxidation was observed in SO which is richer in unsaturated fatty acids than the saturated oils (VCO, CO). The PV ranged from 1.10 mmol/kg to 1.58 mmol/kg in SO devoid of any additive and this was reduced to 0.4 mmol/kg to 0.9 mmol/kg with the addition of pomegranate peel powder. Virgin coconut oil exhibited the highest level of resistance towards oxidation compared to CO and SO. A similar trend was observed with TBARS. The pomegranate peel powder exerted the highest resistance against generation of both primary and secondary oxidative products in edible oils compared to rosemary and oregano extracts. It can be concluded that anti-oxidative extracts such as pomegranate peel powder, oregano and rosemary extracts can effectively be used to mitigate oxidation of edible oils during frying.

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Muscle activity and locomotion changes in dairy cows walking on standard concrete floors and floors covered with slurry

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Lameness in dairy cattle is a major welfare concern that also affects production. The type of flooring in dairy cattle housing is a main contributor for lameness in cattle. Concrete floors are widely used in dairy cattle barns, even though it has been identified as a risk factor for lameness. In addition, accumulation of slurry on the floor is common issue in modern dairy housing and it could inhibit normal locomotion of a cow. Electromyography is an electro-diagnostic medical technique for evaluating and recording the electrical activity produced by skeletal muscles. The objective of this study was to investigate muscle activity and locomotion changes in dairy cows walking on standard concrete floors and floors covered with slurry. Dairy cows walking on standard concrete floors and shallow (5 cm) and deep (10 cm) slurry-covered floors were tested. Nine Holstein Friesian cows (four sound and five lame) were tested according to a walking schedule with treatments balanced among animals.

Surface electromyograms (SEMG) were used to evaluate the total muscle activity of the biceps femoris and middle gluteal muscles. Behavioural measures including average time/ step, stride length and joint angles (stifle angle, floor-foot angle and body angle) at straight and turning positions of walking pathways were also determined in each treatment. The total muscle activity of the middle gluteal muscle was significantly higher ($P < 0.05$) when compared with the biceps femoris muscle, irrespective of lameness condition or treatments. The maximum amplitude of the biceps femoris muscles tended to be reduced ($P = 0.059$) in cows with lameness. The time/ step was significantly ($P = 0.005$) increased when walking on floors covered with 10 cm of slurry. The average floor-foot angle was significantly higher ($P = 0.0001$) in concrete floors than on floors covered with slurry. The interaction between treatment and lameness was non-significant. The variability of the stride length was higher in concrete floors than on slurry-covered floors indicating cows are more careful on surfaces covered with slurry. This study shows the potential of using muscle activity to better understand lameness in cattle kept on different types of floors.

Subacute neurocognitive impairment in organophosphate and carbamate insecticide poisoning

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Neurobehavioural studies suggest that organophosphate (OP) and carbamate insecticide poisoning could lead to subacute/chronic cognitive impairment. The factors that mediate this impairment are hitherto unknown. Using cognitive event related potentials (ERPs) as a neurophysiological marker, our objectives were to determine whether there is a subacute cognitive impairment in patients poisoned with Ops and carbamates, and to investigate the risk factors of cognitive impairment.

We recorded ERPs and reaction time (RT) data in 119 patients discharged from hospitals following OP/carbamate poisoning (Test Group) and 29 control subjects. P300 ERP waveforms were derived from averaged EEG recorded at FZ, CZ and PZ scalp sites during a standard auditory 'oddball' task where the subjects responded to target tones while ignoring the standard tones. RT, P300 peak latencies and amplitudes, were compared between two groups adjusting for confounding variables. The risk factors of cognitive impairment in the Test Group was analysed using multiple linear regression (MLR) models.

Once adjusted for other variables, mean P300 amplitude was 2.4uV smaller (~ 43% reduction from the mean of the controls) at FZ (P = 0.025) and 2.7uV (~ 40%) smaller at CZ (P = 0.025) in the Test Group. Once adjusted for other factors, the Test Group patients who developed hypoxia had a 49.4-ms delay in RT compared to those who did not develop hypoxia. Hypoxia also tends to increase the P300 latencies at fronto-central sites (a delay of 17.4ms at FZ and 20.4ms at CZ) but the effect was not statistically significant. Those who had a major psychiatric illness also showed delayed P300 latencies in fronto-central sites. Once adjusted for other variables, psychiatric diagnosis delayed P300 latency at CZ by 34.1ms (P = 0.031) and tended to delay P300 at FZ (P = 0.092).

Our findings indicate that acute poisoning of OP and carbamate insecticides may impair cognitive functions as indexed by RT and P300 cognitive ERPs. Hypoxia seems to play a role in this impairment. The neurocognitive impairment that outlasts clinical illness implies sub-acute effects of the insecticides on brain function.

Prevalence of low birth weight and associated maternal factors in Vellavely Medical Officers of Health area

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The World Health Organization (WHO) defined Low Birth Weight (LBW) as a condition where the weight at birth of a baby is less than 2500 grams. LBW is a major determinant of prenatal survival, infant morbidity and mortality as well as the risk of developmental disabilities and illness throughout future lives. This study provides information on the prevalence of low birth weight and associated maternal factors in the Vellavely Medical Officer of Health (MOH) area from 2012 January to 2014 December. The main objective of this study was to investigate the prevalence and associated maternal factors of low birth weight. Specific objectives were to evaluate the prevalence of low birth weight and to determine the association between the prevalence of low birth weight with maternal age, maternal hemoglobin level, gestational weight gain and maternal Body Mass Index (BMI).

A retrospective cross-sectional study was done in singleton pregnant women to find out the prevalence of LBW and associated maternal factors at the Vellavely MOH area, 319 birth details were randomly extracted among all birth records from January 2012 to December 2014 in all 15 Public Health Midwife (PHM) areas in Vellavely MOH division. The secondary data source was the maternal registered book of the Vellavely MOH. Maternal age, maternal haemoglobin level, weight, height, pre delivery weight and birth weight of newborn were the collected data.

The prevalence in the present study was 27.3%. Maternal hemoglobin levels and maternal weight gain were analyzed with LBW by using the chi – square test. The chi- square p-value of the analysis was 0.009 and 0.004 respectively. Maternal hemoglobin and gestational weight gain are associated factors with low birth weight. Implementing health education programs and health care quality delivered to pregnant women and consequently supplementation of iron and nutritional tablets may reduce the chances of the birth of low birth weight neonates.

Patient centered attitudes of Sri Lankan medical graduates assessed by Patient Practitioner Orientation Scale (PPOS)

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Patient centeredness is a trainable attribute for health care professionals that could be influenced positively as well as negatively by the undergraduate curriculum. Patient centeredness denotes compassionate and respectful delivery of care, adopting a parallel position in sharing information and collaborative planning. The value of such an approach with regard to patient satisfaction, cost effectiveness, therapeutic efficacy and doctor satisfaction has been documented.

Assessment of patient centeredness of doctors becomes valuable for research and evaluation of educational interventions. The objective of this study was to determine patient centeredness among graduates of six medical faculties in Sri Lanka, just before they start practicing.

The validated Sinhala version of the patient practitioner orientation scale (PPOS), which is a widely used, validated, 18 itemed, self-reporting instrument that measures the caring and sharing attitudes, was used. The questionnaire was administered to 1200 doctors who had received appointments as interns in June 2013, at a common lecture at the beginning of internship. Participants were given the choice of selecting either the Sinhala or English version of the PPOS. Fifty six percent were females. The average sharing, caring and total PPOS values were 3.00(0.66), 2.4(0.67) and 2.7(0.589). Sharing, caring and total PPOS values for females and males were 2.97(0.65), 2.33(0.63), 2.65(0.55) and 3.05(0.68), 2.49 (0.72) and 2.77(0.61) respectively. Sharing, caring and total PPOS values for the top 1/3 in merit order and the bottom 1/3 in merit order were 3.05 (0.47), 2.26(0.51), 2.65 (0.36) and 2.99(0.77), 2.39(0.76) and 2.69(0.68) respectively. After eliminating 4 faculties with a very small number of respondents sharing, caring and total PPOS values for foreign graduates, medical faculties with highest and lowest PPOS scores were 3.26 (0.75), 2.67(0.46), 2.78 0.56) and 3.09(0.84), 2.48(0.88) 2.78(0.78) and 2.81(0.57), 2.13(0.52) and 2.48(0.57) respectively.

Overall, PPOS values of Sri Lankan medical graduates are lower than that observed in medical graduates in western countries and slightly higher than those graduating from Nepal, Pakistan and India. A Higher PPOS value among foreign graduates is a notable observation even though it is not statistically significant. A Lower PPOS value seen among females is also an unusual finding compared with the international literature which consistently documents higher PPOS values among females.

Developing a self-appraisal tool for intern medical officers in Sri Lanka

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Medical graduates are expected to have a wide spectrum of competencies that extend beyond knowledge and skills. Current practices of evaluation in medical education do not support assessment of the entire spectrum of competencies, hindering the possible drive of assessment for learning and teaching, resulting in marginalized attention to competencies other than knowledge and skills. The practice of compulsory workplace based assessment during internship, which assesses all doctors during a period of six months by a senior consultant, would provide valuable feedback to medical faculties. Therefore, developing a comprehensive tool for appraisal of intern doctors was undertaken. A tool for appraisal of competencies was developed by three stages. Initially, a 30-item tool was developed following a literature review. Secondly, it was refined by expert opinion and thirdly, further improvement after field-testing and discussion with stakeholders was done. The research team further refined the checklist to 20-items after several informal focus group discussions. A suitable guide to express responses in a Likert scale was developed. The items in the final tool includes: demonstrating and applying basic and clinical sciences knowledge; history taking and examination skills; managing emergencies, non-emergency patient management of common conditions, procedural skills related to patient care; written communication skills, solving non-medical problems, communication with patients, parents and relatives; showing empathy and compassion for patients, showing respect for patients and other health care workers; effective collaboration with the team, interest in non-medical activities, administrative and managerial skills; teaching students, colleagues, and other health workers; research, audit and critical thinking skills; commitment for work, commitment for further learning, acknowledging own limitations and seeking help when appropriate; and taking responsibilities according to the role as an intern. The appraisal checklist was administered to 540 intern doctors as filed testing. Results show a segregation of items into 4 groups: core knowledge, psychosocial aspects, scholarship and commitment for work. Results of this study were presented to a forum representing all the medical faculties, the Sri Lanka Medical Council (SLMC) and the Ministry of Health. The workshop participants evaluated the tool and modified items and suggested developing a shorter version with 18 items with evaluation of feasibility and expression of personal opinion. A useful tool for self-appraisal of intern medical officers' competencies was developed that could be used for appraisal on intern doctors' performances. Information gathered could be utilized to monitor teaching programs in medical faculties. This study is limited only to self-appraisal, but the real value of the tool would be harnessed only when a supervisor completes it after the observation of performance as a doctor over a period of time.

Student performance and perception regarding descriptive and clinical case based anatomy questions

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Anatomy is largely a descriptive science, however when teaching anatomy to medical students, teaching pure anatomy has lost its usefulness. A debate exists as to which aspect should be assessed at exams. While certain groups stress the importance of asking questions related to clinical cases, others say that questions should focus more on description of structures. It was the objective of this study to quantify the performance and ascertain the first year student perception of these two types of questions.

Students in the 1st year 2nd semester at the Faculty of Medicine Peradeniya, were recruited. They were given 2 questions similar to exam questions from a familiar area. One question was descriptive and the other was a clinical case scenario. Students were given 30 minutes to answer. Scripts were marked according to a marking scheme and scored out of hundred. At the end students were asked, which type was easy, which type should be included in assessments and which type they preferred with reasons using a questionnaire.

There were 192 students and all had answered both questions. Average scores were 73.24% for the descriptive question and 65.67% for the clinical case scenario. Of the students 65.3% thought that the clinical case scenario type of question should be given for assessments while 58% said that they preferred to answer this type of question. Eighty two percent said descriptive type of question was easy.

As expected a majority of students scored highest marks in the descriptive type of question, while they scored less for the clinical cases. It was interesting to see that even though the students as an average had scored fewer marks for the clinical cases question the majority thought this type of questions should be given for assessments. The reasons given were, they thought it would help them in their future years and that such questions were more interesting and challenging.

It is evident from these findings that even though students score better in descriptive type of questions a majority think that clinical case based type of questions should be included in assessment and they prefer to answer such questions.

Platelet Rich Plasma (PRP) as a treatment for androgenic alopecia in males

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Platelet Rich Plasma (PRP) is a solution enriched with platelets and it is derived from whole blood. Platelets serve as a reservoir of growth factors and cytokines. When platelets are activated in vivo, signaling molecules are released into the immediate microenvironment and activate receptors for various pathways. Recently PRP has been utilized for the treatment of male and female pattern of alopecia. Here we are hoping to evaluate the effectiveness of the PRP treatment in androgenic alopecia in male patients.

Male patients with androgenic alopecia were recruited to the study. Informed consent was taken from all the patients. To prepare PRP, blood was drawn using a butterfly cannula and acid citrate dextrose (ACD) was used as the anticoagulant (9:1) The centrifugation process was carried out with a standard laboratory practice in 2 steps as soft spin & hard spin. The patient was first anesthetized with a local anesthetic cream. Prepared PRP was injected into the affected bald area of scalp monthly for 3 months. Patients were monitored photographically.

A total number of 14 male patients were recruited. Their ages range from 22yrs to 40yrs and initial stage of baldness range from stage 2 vertex to stage 7 according to the Modified Norwood Hamelton (MNH) scale. At the end of the 3rd month, 4 patients showed 75% of improvement, 5 patients showed 50-74% improvement and 5 patients showed 25-49% of improvement. None of them got any other adverse effects.

Androgenic alopecia is a challenging condition to treat. PRP was introduced as a promising treatment modality and its popularity is increasing as a successful treatment. However, there is no gold standard method and each practitioner uses his/her own protocols. The advantage is lack of serious side effects, and disadvantages are pain at the injection site and high cost in preparation of the PRP. PRP can be considered as a safe & effective tool to treated male pattern androgenic alopecia.

Association between taste sensation and dental caries experience among dental students

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High sugar intake is related to high caries experience. High sugar intake is found to be prevalent among individuals who have a preference for sweet substances. Sensitivity to taste has been implicated in the preference for or rejection of some foods. It has been shown that TAS2R38 gene strongly mediate bitter and sweet taste sensations as well as the sensitivity to compounds like 6-n-propylthiouracil (PROP) which is a known bitter substance.

The objective of this study was to determine the association between coronal dental caries (Decayed Missing and Filling teeth) and the level of taste sensation as determined by 6-n-propylthiouracil among dental students.

Coronal caries and restorations in permanent dentition were assessed in 78 healthy first year dental students aged 20-25 years. A filter paper containing PROP was used to determine the subjects' inherent ability to perceive bitter and sweet taste sensations. Subjects were categorized in to three groups; super tasters (>60), medium tasters (12-60) and non-tasters (<12) based on the modified green scale which depends on the sensitivity to PROP. The data were analyzed using Shapiro-wilk and Kruskal- wallis tests.

The mean DMFT of non-tasters, medium tasters and super tasters were 1.64 ± 2.04, 2.38 ± 3.24 and 1.96 ± 2.31 respectively. The differences between the three groups were not statistically significant ($P= 0.7$). The findings of the present study are in agreement with some previously reported studies. However the presence of evidence to the contrary warrants further investigation using larger populations.

Evaluating probiotic attributes of *Lactobacillus* sp isolated from plaque samples taken from female adults with dental caries

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Probiotics are defined as an adequate amount of live microorganisms able to confer health benefits on the host. Lactic acid bacteria are key microbial species which show probiotic properties. Among all lactic acid bacteria, genus *Lactobacillus* is considered as the main type of organism with probiotic properties. *Lactobacillus* species are identified as a causative agent of dental caries. Hence plaque samples from dental caries can be taken as a potential source of probiotic *Lactobacilli.* The aim of this study was to identify, evaluate and differentiate the probiotic attributes of *Lactobacillus* sp isolated from plaque samples taken from female adults with root and pit and fissure dental caries.

A total of thirteen (13) *Lactobacillus* isolates were obtained from pit and fissure dental caries plaque samples and a total of twenty one (21) *Lactobacillus* isolates were obtained from root dental caries plaque samples, after screening thirty (30) samples of each, which were identified based on their colony morphology and some biochemical characteristics including endospore formation, negative motility and catalase negativity. All *Lactobacillus* isolates were evaluated for their probiotic attributes including resistance to bile salt, resistance to low pH, DNase activity, haemolytic activity, antimicrobial activity against pathogens, *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia* and *Candida albicans,* and antibiotic resistance against nalidixic acid, ampicillin, norfloxacin and ciprofloxacin.

It was evident from the results that all isolates were unable to survive at 0.3% bile concentration except three isolates (RC 19.1, RC 20.1 and RC 26.2) from plaque samples of root dental caries patients. However the viable colony count decreased with time. None of the isolates were able to survive at low pH 3.0 and none of them were able to exhibit antimicrobial activity against the five pathogens used. All isolates were found to be DNase negative, and α haemolytic. Furthermore, all isolates were found to be sensitive to the antibiotics used in the study. In conclusion *Lactobacillus* species can be successfully isolated from plaque samples taken from dental caries. The percentage of *Lactobacillus* of plaque samples taken from root dental caries was higher (70%) than the *Lactobacillus* percentage of plaque samples taken from pit and fissure caries (43%). To be considered as probiotic bacteria, it is essential to obtain decided results for all probiotic tests. Hence the present study showed that none of the *Lactobacillus* isolates obtained from plaque samples of female adults with root and pit and fissure dental caries can be used as potential probiotic bacteria.

Abstract No: 44   *Health Sciences*

Factors associated with the uptake of cervical cancer screening among married women in Udagangoda Grama Niladhari Division, Ratnapura district, Sri Lanka

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Cervical cancer is a major public health problem throughout the world. It is the second leading cause of cancer related deaths among women in Sri Lanka. Screening is one of the most cost effective strategies for disease control.

This study aimed to identify the factors associated with the uptake of Cervical Cancer Screening among married women in age at or above 35 years in Udagangoda Grama Niladhari Division, Ratnapura District in Sri Lanka.

A descriptive cross-sectional interviewer administered questionnaire survey was conducted among 170 women. Data were analyzed in SPSS 16.0 statistical software. Statistical significance was set at $p < 0.05$.

Mean age of the participants was 52.6. Out of them 54.7 % (n=93) had passed O/L and 60 % (n=160) were unemployed women. Almost 87.6 % (n=149) had heard of cervical cancer (CC) and 87.1 % (n=148) had of heard cervical cancer screening (CCS). A very small proportion of participants had heard of risk factors, signs and symptoms and the link between HPV (Human Papilloma Virus) and CC, that is 2.3 % (n=4), 11.2 % (n=19) and 2.9 % (n=5) respectively. Electronic media and midwives play a great role in providing information on CC and CCS. Even though a majority of them had of heard the disease and screening method, screening uptake was very low among the participants 19.4 % (n=33).

Age and educational level played key roles in determining the awareness and attitude of the women. At the same time proper awareness and positive attitudes affected to determine the screening behavior of the respondents. The proportion of women who had ever been screened was significantly higher among those who demonstrated a positive attitude to screening. 78.8 %(n=26), $p = 0.001$, respondents were aware of the disease 100.0 %(n=33), $p = 0.016$, and those who were aware of cervical cancer and its screening were 100.0 % (n=33), $p = 0.001$).

These findings highlighted a busy schedule in life: 43.5% (n=74) and lack of knowledge: 30.6% (n=52) and were the most common barriers towards utilizing screening services. There is an urgent need to improve proper awareness programs, and changing attitude to overcome low attendance for screening services in Sri Lanka.

Burden of tobacco smoking and its awareness

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Tobacco smoking is one of the leading causes of cardiovascular and respiratory diseases burdening the society. Smoking adversely affects individuals who smoke (first hand smoking), those who inhale smoke by being near smokers (second hand smoking) and those who are exposed to nicotine and other toxic residues left on indoor surfaces due to tobacco smoke (third hand smoking).

The present study aims to describe the pattern of exposure of individuals to smoking, the socio- economic factors associated with smoking and the awareness on the health effects of being exposed to tobacco smoke in Gangawata Korale Medical Officer of Health (MOH) area in Sri Lanka.

A cross sectional descriptive study was done with 648 randomly selected subjects using a self-administered questionnaire. Their awareness regarding the health effects of first hand, second hand and third hand smoking was assessed in three categories. Half or more correct answers in each category were considered as "Satisfactory Awareness" for that category. A separate section assessed smoking habits. The data was analysed using SPSS (Version 20).

Of the sample, 48% were males. The ages ranged from 18 to 44 years (mean=30). Ninety (14%) of the sample were smokers and almost all (98.9%) of them were males. There was a significant correlation between the level of education and smoking, the better educated were more likely to be non-smokers (P< 0.001). The awareness on the health effects was found to be satisfactory in 499 (77%) regarding first hand smoking, 418 (64.5%) regarding second hand smoking and 305 (47.1%) regarding third hand smoking. There was a significant correlation between the level of education and the satisfactory awareness on the health effects of smoking (P=0.035)

Public awareness campaigns mostly address first and second hand smoking. The novelty of the concept of third hand smoking is reflected in the limited awareness shown by the participants.

Although the study population is aware about the health effects of first hand smoking and second hand smoking, the awareness regarding third hand smoking is lacking. Educated people tend to be non-smokers with better awareness about the effects of tobacco smoke on health. Interventions should target uneducated males. The issue of third hand smoking need to be highlighted in awareness programmes.

Quality of life and co-morbidities among male patients with Chronic Obstructive Pulmonary Disease (COPD) attending the District Chest Clinic, Kandy

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COPD is a disease state resulting from progressive irreversible airflow limitation. It is common among tobacco smokers. The symptoms include chronic cough with sputum production and difficulty in breathing (dyspnoea) on exertion resulting in limitations in physical activity with harmful effects on quality of life (QOL). COPD is associated with co-morbid conditions like ischemic heart diseases, osteoporosis, respiratory infections, diabetes mellitus, hypertension, and lung cancer. The objectives of this study were to assess the QOL of COPD patients and to determine how their QOL is associated with other co-morbidities, with number of exacerbations of the disease and with the degree of dyspnoea.

A descriptive study was conducted among 200 male COPD patients attending the District Chest Clinic, Kandy. Patients who cannot understand the Sinhala language and patients with epilepsy, cancer (except lung cancer), mental health conditions and arthritis were excluded. Data was collected using interviewer administered questionnaires. The validated 'Short Form 36' questionnaire and the 'modified Medical Research Council dyspnoea scale' were used to measure the QOL and severity of dyspnoea respectively. Co-morbidities were assessed using a WHO guided questionnaire.

The mean age of the study population was 61.5 years (SD=8.95). Out of the study population, 66.5% (n=133) had poor QOL. The QOL was significantly reduced with increased severity of dyspnoea ($p<0.001$) and increased number of exacerbations of symptoms ($p=0.001$). The commonest co-morbidity of the study population was hypertension (45.5%). Although the QOL become poorer with increased number of co-morbidities, the association was not statistically significant ($p=0.09$). Among the participants, 62 did not have a single co-morbid condition. However, 53.2% of them had poor QOL.

Most of the male COPD patients attending the District Chest Clinic, Kandy had poor QOL. As dyspnoea and exacerbations of symptoms greatly affect the QOL, effective patient management and health promotion programmes are necessary to improve the QOL of COPD patients.

Abstract No: 54   *Health Sciences*

Hypolipedimic effect of water extract of *Trigonella foenum-graecum* seed

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Hyperlipidemia is an abnormal elevation of triglyceride and/or cholesterol concentrations in blood, which leads to many health disorders such as obesity and atherosclerosis. Although many synthetic lipase inhibitors are available for controlling hyperlipidemia, they are likely to be associated with adverse side effects. Thus the aim of this study was to evaluate the in-vitro and in-vivo hypolipidemic effects of the water extract of *Trigonellafoenum-graecum* (fenugreek) seeds.

Crude methanol extract of *T. foenum-graecum* seeds was partitioned with n-hexane and methanol, the resulting methanol extract was partitioned with ethyl acetate and distilled water. All extracts were used to determine the in-vitro lipase inhibitory activity by a lipase inhibition assay using 2, 3-dimercapto-1-propanoltributyrate as the substrate. As the water extract (WE) was found to have significant lipase inhibitory activity it was used for the in-vivo study. In- vivo lipid loading test was conducted using twenty male Sprague Dawley rats; the treatment group was orally administered with WE at the dose of 2000 mg/kg while the control group received distilled water. After 30 minutes, both groups were orally administered with coconut oil at the dose of 5 ml/kg. Rats were bled at 60, 120. 180 and 240 minutes and the gavage of coconut oil and serum triglyceride levels were analysed.

WE showed a significant (p<0.05) dose dependent percentage lipase inhibition in-vitro with an IC$_{50}$ value of 2.86 mg/ml. In the in-vivo study, both treatment and control groups had similar triglyceride levels (1.18mmol/l) initially which in both groups increased until 180 minutes, and declined thereafter. However triglyceride levels of the treatment and control groups at 60 min were1.35 and 1.67mmol/l and at 180 min were 1.72 and 1.89 mmol/l respectively, displaying a lower level in the test group throughout.

The results indicated that WE exhibit inhibitory activities against pancreatic lipase in vitro and in vivo. To date lipase and dietary fat absorption activities by lipid loading test using coconut oil has not been reported for *T. foenum-graecum* seeds water extract. Results presented here conclude that WE could be accepted as a useful and safe natural hypolipidemic agent.

Physical activity patterns among persons with diabetes attending the National Diabetes Centre, Sri Lanka

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Physical Activity (PA) and exercise have proven to prevent and control diabetes. Diabetes is a costly health burden in Sri Lanka, while effective diabetes management with exercise may be a cost-effective strategy than prescribing drugs alone. However, it is important to evaluate various PA domains in order to prescribe suitable exercise patterns. But such records for diabetes patients are limited in Sri Lanka. The objective of this study was to assess the prevalence levels of domain-specific and overall PA among diabetes patients attending the National Diabetes Centre.

A descriptive cross sectional study was carried out for 105 randomly selected patients attending the National Diabetes Center, where PA was assessed using the validated long version of International Physical Activity Questionnaire (IPAQ). After assessing the domain-specific and overall PA level, patients were categorized as highly active, moderately active and insufficiently active according to the IPAQ guidelines.

The sample consisted of 55 males and, 50 females with the mean age of 43.70 ± 19.103 years. Highest overall distribution of PA was recorded from 'domestic and yard work' domain (81% of the sample involved in PA), while the domains of 'leisure' (40%) and 'job' (35.2%) had the least PA. Most diabetics (86.7%) tend to involve in moderate PA, whereas vigorous PA was the least prevalent activity type (16.2%) in the study sample. With regard to overall PA, 43.8% of diabetics were found to be highly active, while 35.2% were moderately and 21% were insufficiently active.

Although our results revealed that most of the diabetes individuals in the sample were sufficiently active, they were less involved in exercise during their leisure domain, which is vital to be reversed. The findings of this study will help clinicians to plan suitable exercise sessions for diabetes individuals especially targeting their leisure domain. Extension of this study to all diabetes centers in Sri Lanka and promoting leisure time physical activities would be of national importance.

Comparison of acute effects of fast tempo and slow tempo music on pre-competition anxiety level among university rugby players

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Anxiety is a common psychological trait that depresses optimal sports performance in any sport. It is an important factor similar to stamina or physical capacity. Hence it is important in decision making and reaction to any situation in a competitive stage of an event. It has been shown that listening to music during the pre-competition stage has positive effects on the player's performance, and downregulating unpleasant emotions; anger, confusion, depression, fatigue and tension. The purpose of this study was to determine the effectiveness of slow tempo and fast tempo music in down regulating pre-competition anxiety levels of athletes.

Twenty university level male rugby players volunteered to take part in this study. Mean (SD) characteristics of participants were as follows: age 22.9 (1.8) years; height 1.65 (0.05) m; body mass 83.8 (8.7) kg; playing experience 2.4 (1.4) years. The subjects were assigned to two groups - group A and group B randomly. A pre-test was conducted before the warm up session to assess the baseline anxiety level of the players of both groups. Fast tempo western music (120-130 beats per minute) and slow tempo western music (50-60 beats per minute) were used for a duration of 15 minutes during their warm up session as treatment for group A and group B respectively. The players were instructed to listen to a particular type of music while they were doing warm up exercises. A post-test was conducted to assess the pre-competition anxiety levels. Competitive State Anxiety Inventory-2 (CSAI-2) was used in pre-test and post-test to assess the anxiety level.

Results of the study revealed the pre-test mean values as 31.7 and 31.6 for group A and group B respectively. Post-test mean values were 27.7 and 30.4 for group A and group B has lower values than their baseline values respectively. The anxiety level in the players of group A significantly decreased ($P < 0.05 = 0.034$) compared to that of the players of group B with 95% confidence interval. Within the confines of this study, it can be concluded that listening to fast tempo music in the pre-competition stage has a positive impact on downregulating the pre-competition anxiety level.

A rare case of stomach perforation inside the thoracic cavity due to a congenital diaphragmatic hernia in an adult

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Congenital diaphragmatic hernia (CDH) is a defect that occurs due to abnormal development of the diaphragm, with herniation of the abdominal contents into the chest. We present an extremely rare case of perforation of stomach which has herniated through the diaphragm in an adult, causing pleural effusion and an empyema thorax.

A 40 year old male presented with a three day history of left side chest pain and dyspeptic symptoms. His heart rate was 124 beats per minute, blood pressure was 110/70 mmHg and the respiratory rate was 28 breaths per minute. Air entry was low on the left side. The abdomen was tense but not tender. Urine output was less than 1ml/Kg/hr. A chest X-ray revealed a left side hydro-pneumothorax and so a tube thoracostomy was performed. Following the procedure the patient had intestinal contents draining through the tube. Urgent non-contrast computerized tomography (NCCT) of the thorax was performed. It revealed intestinal contents inside the left hemithorax with pleural effusion. The left lung has collapsed due to a massive pneumothorax with mediastinal shift. An urgent left thoracotomy was performed. The stomach, part of the omentum and spleen were herniated through postero-lateral (foramen of Bochdalek's) diaphragmatic defect. A perforation of 1.5 cm was found on the anterior surface of the stomach with gross contamination of the left hemithorax. The lower lobe of the left lung has collapsed. The pleural cavity was washed thoroughly. Perforation was repaired with 2/0 PGA interrupted suturing. A midline laparotomy was performed on lateral position. A congenital defect of the diaphragm was identified and repaired with 2 Nylon interrupted. A thoracotomy was closed with chest drain in situ. The peritoneal cavity was washed and closed over a drain in supine position. A post-operative chest X-ray revealed fully expanded left lung with the left hemi diaphragm located in the normal position. He developed empyema of the thorax and had full thickness burst of the upper abdomen which was managed accordingly. The patient recovered and was discharged from the ward after 14 days of hospital stay.

Although congenital diaphragmatic herniae are seen among children, presentation in adults is rare. Perforation of viscera in such a case is even a rare occurrence where a high degree of suspicion is required to identify and manage the condition. Standard thoracotomy with laparotomy on lateral position gives optimum exposure for surgery for such cases.

Use of Information and Communication Technology (ICT) for controlling Oral Potential Malignant Disorders (OPMD) in Sri Lanka

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In Sri Lanka, breast cancer has the highest reported incidence among females, whereas the same for males is reported to be the cancers in the lip, oral cavity and pharynx. Majority of patients with oral cancer and OPMD are detected by dental surgeons and the suspected cases are referred to Oral and Maxillofacial units (OMF) in state hospitals. The National Cancer Control Programme (NCCP) of the Ministry of Health conducts surveillance of cancers in Sri Lanka. There are several pitfalls in the current manual paper-based oral cancer surveillance system which hinders the NCCP's performance in disease surveillance and control activities. The goal of the new system (SLOPMD) established in the Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya is to strengthen OPMD surveillance using ICT. The SLOPMD (www.slopmd.com) surveillance system has been designed in three phases. Phase I is designed to use the retrospective data available at the Department and Phase II is upgraded for prospective data collection. Phase III will connect countrywide OMF clinics to the system providing a key improvement in the current perspectives of oral cancer surveillance in Sri Lanka. The vision of using Health Informatics for public health is to improve the high value data, information, and knowledge to be exchanged in a secure and timely manner. World Health Organization has stated that reporting of notifiable diseases by making use of modern communication technology and reporting of statistics is advancing. The SLOPMD system will serve as a key web-based method and one of the core indicators of the country's health performance. As a developing country, Sri Lanka needs to deliver quality health care to its citizens and to improve cancer surveillance in Sri Lanka.

Positive findings and breast cancer: prediction through the mammographic x - ray examination among a selected population, Sri Lanka

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Mammography x-ray examination is a gold standard method for detection of breast cancer. This cross sectional study describes the risk factors to positive finding of breast cancer and their association among Sri Lankan women who underwent mammography examination. Data were collected for six months at a selected private hospital in Sri Lanka in 2015. A structured questionnaire was distributed among the patients prior to mammography x-ray examination. It included demographic information of patients and signs and symptoms, surgery related risk factors, and other related factors were considered as associated risk factors for breast cancer. All mammographic images were interpreted and reported by a well experienced radiologist at a particular hospital.

Mammographic examinations were performed on 213 consecutive women, and among them 120 women were diagnosed as positive for breast cancer. 41 (34.16%) women came for screening and 79 (65.83%) for diagnostic mammograms. Among the positive diagnosis of women, 65 (54%) had pain and 62 (51.6%) had palpable mass in one or both breasts. Changes of shape in breast was observed in 27 (22.5%), 46 (38.4%) had none or low breast feed, 81 (72.5%) use contraceptive pills, 67 (55.8%) have family history of breast cancer and 71 (59.16%) were in menopause period. A binomial logistic regression was performed to see the factors which can be predicted towards the positive finding. The Hosmer-Lemeshow test showed that the model fitted the well: ($p=0.544$). None or lack of breast feeding, usage of contraceptive pills and family history showed a statistical significance: ($p <0.05$) on prediction of positive finding. However, the pattern of menses was not a statistically significant ($p > 0.05$) predictor. The study concluded that pain and palpable mass or lumps are good indicators. It is evident that mammogram being positive is 7.18 times higher in those with family history of breast cancer than those without a family history. Furthermore, family history of breast cancer, usage of contraceptive pills and none or lack of breast feeding were identified as higher risk factors in predicting the positive finding to breast cancer. However, biopsy procedures should be performed to confirm the positive findings.

Comparison of wound healing potential of papaya peel dressing with povidone-iodine dressing on diabetic foot ulcers

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A diabetic foot ulcer is a non-healing or poorly healing full-thickness wound, through the dermis under the ankle in an individual with diabetes mellitus. There are approximately 10 million of diabetic ulcers in the world that require treatment every year. Diabetic wounds may never heal or may take years to heal. These wounds cause severe emotional and physical stress, pain and create a significant financial burden on patients and the health care system. Unripe papaya peel dressings are also used for chronic wounds in clinical practice these days. The present study was carried out to compare the efficacy and safety of the papaya peel dressing (PPD) with povidone-iodine dressing (PID) for Wagner type II diabetic foot ulcers.

Sixty two patients with informed consent were enrolled in the study, whose ulcers had been diagnosed as chronic diabetic foot ulcers and were prescribed either PPD or PID by the surgeon concerned. Thirty one patients were treated with PID while the remaining 31 patients were treated with PPD. The efficacy parameters were the duration of time required to induce the development of healthy granulation tissues and the requirement of surgical debridement during the treatment.

Time required to induce development of healthy granulation tissues was 14.61 ± 1.4 days in the group treated daily with PID and 7.74 ± 1.9 days in the group treated daily with PPD ($P = 0.0001$). The number of patients who required surgical wound debridement during treatment in the PID group was 15 and in PPD group was 2. Efficacy parameters significantly improved in the PPD group compared to the PID group. The frequency of adverse effects like local irritation and itching were similar in both groups and the difference was not statistically significant ($P = 0.452$). Pain level was also compared in both groups and there was no significant difference noted ($P = 0.728$). No complications like infections occurred in either group.

Taken together, the PPD is more efficacious and equally safe compared to the PID in treating patients with diabetic foot ulcers. Moreover, the cost-effectiveness and the availability make PPD a better treatment option for diabetic foot ulcers.

Biomonitoring of 18 trace elements in human hair and nail from inhabitants of Girandurukotte and Kandy by ICP-MS

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An alarming increase of chronic kidney disease with unknown etiology (CKDu) has recently been reported in several provinces in Sri Lanka and chronic exposures to toxic trace elements were blamed for the etiology of the disease.

Keratinized matrices such as hair and nails were investigated in order to find out the possible link between CKDu and toxic element exposures. Elements: Li, B, Al, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Cd, Ba, Hg and Pb of hair and nails of patients from Girandurukotte and age-matched healthy controls from Kandy were determined with Inductively Coupled Plasma Mass Spectrometer (ICP-MS).

The results showed that trace element contents in hair of patients vary in the order of Zn> Fe> Al> Mn> Cu> Ba> Sr> Ni> Pb> Cr> B> Hg> Se> Mo> Co> As> Li> Cd while Fe> Al> Zn> Ni> Cu> Mn> Cr> Ba> Sr> B> Pb> Se> Mo> Co> Hg> Li> As> Cd in nail samples. The hair As levels of 0.007 to 0.165 $\mu g\ g^{-1}$ were found in CKDu subjects; however, no significant difference was observed between cases and controls. The total Se content in hair of CKDu subjects ranged from 0.043 to 0.513 $\mu g\ g^{-1}$ while it varied from 0.031 to 1.15 $\mu g\ g^{-1}$ in controls. Selenium in nail samples varies from 0.037 $\mu g\ g^{-1}$ to 4.10 $\mu g\ g^{-1}$ in CKDu subjects and from 0.042 $\mu g\ g^{-1}$ to 2.19 $\mu g\ g^{-1}$ in controls.

Despite the gender, age and occupational exposure, this study implies that substantial proportions of the Sri Lankan population are Se deficient. Although cutaneous manifestations were observed in patient subjects, chemical analyses of hair and nails indicated that patients were not exposed to toxic levels of arsenic or other studied toxic elements. Therefore, early suggested causative factors such as exposure to environmental As and Cd can be ruled out.

Abstract No: 79   *Health Sciences*

Post–MDA surveillance for transmission of lymphatic filariasis in the Colombo and Gampaha districts of Sri Lanka

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In the year 2002 the national Anti-filariasis Campaign launched the program for elimination of lymphatic filariasis (LF) by annual mass drug administration (MDA) of diethylcarbamazine citrate and albendazole to the eligible at risk population in the three endemic provinces of Sri Lanka. The program was concluded in 2006 after completing five rounds of treatment with coverage exceeding the goal of 80%. Recently, Sri Lanka received certification of elimination of LF.

Screening for LF was done in two consecutive time periods (2009-2010 and 2013-2015) in the districts of Gampaha and Colombo using the thick night blood smears (NBS), and in 2015 children were screened for antibodies to *Brugia malayi* with a rapid dipstick test (Brugia Rapid, Reszon Diagnostics International, Malaysia).

A total of 2,461 individuals (mean age 32.05, range 4-80 years, male: female ratio 1:1.01) from the districts of Colombo (17.4%), and Gampaha (82.8%) were screened by NBS and 250 children (7-12 years) were screened for antibodies to *Brugia malayi* with a rapid dipstick test.

During 2009-2010, examination of 1,257 NBS from Angoda (2009), Mathumagala (2010), Welisara 2010) and Galwala (2010) revealed four *Wuchereriabancrofti* microfilaria (mf) positives (mf rate 0.32%). During 2013-2015, examination of 1,204 NBS from individuals living in Kandaliyaddapaluwa (2013), Galwala (2015) and Wattala (2015) of Gampaha district revealed one *B. malayi* mf positive (mf rate of 0.08%).Of 250 children surveyed for antibodies to *B. malayi* in the Gampaha district, 1.6% (n=4) demonstrated evidence of exposure to *B. malayi* infection, which was hitherto regarded as an infection of the past.

This survey provides supportive evidence on the success of the annual MDA program in achieving elimination of bancroftianfilariasis in the western province and suggests the need for further studies on brugianfilariasis in the country.

Review of literature in identifying biomarker profile for CKD-U patients in Sri Lanka

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Chronic Kidney Disease due to unknown etiology (CKD-u) is a deadly disease. Its prevalence has been identified in several countries in North Central America, India & Sri Lanka. CKD-u is most pronounced in the North Central Province (NCP) of Sri Lanka. CKD-u is slowly progressive, irreversible and asymptomatic until late stages and is not attributable to hypertension, diabetes or other known etiologies. Current management of CKD-u is based on the evidence obtained from general management of CKD as there is a limitation of clinical data on this specific clinical syndrome. Available limited evidence and extrapolated evidence from other diseases with similar pathological involvement like, Chinese herb nephropathy, analgesic nephropathy, Balken nephropathy suggest that mainstays of management of CKD are not applicable to tubular interstitial diseases. Blood pressure control and proteinuria reduction are good examples. In this background it is highly important to identify the exact natural history, complications and possible therapeutic interventions for better patient care. There are various models to investigate those aspects of a disease and we feel that description of biomarker profiles at various stages of this unknown disease will be a vital step. The present study focused to conduct a literature search to identify available biomarkers which could represent various unknown pathophysiological mechanisms of CKD-u.

Published articles on CKD-u and CKD were reviewed and the most relevant biomarker profile to describe possible biomarker expression in CKD-u was identified. Studies were identified through a systematic search of Pubmed and other websites using key terms: biomarkers, chronic kidney disease; and papers were scrutinized for additional references. According to articles such as Kidney International, Diabetes Care, Nature Reviews Nephrology etc. routine & novel biomarkers were categorized according to their renal relevance for the CKD-u.

In this article, novel biomarkers & routine investigations are critically reviewed and bound with other relevant literature with a view to justify the renal relevance of the selected biomarkers for early identification of CKD-u. This study reviews a most relevant biomarker profile for CKD-u in Sri Lanka.

Is there any relationship between Body Mass Index (BMI), selected anthropometric parameters and body fat percentage?

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In clinical practice, use of Body Mass Index (BMI) and anthropometric parameters as indicators of obesity is easy, but their reliability as tools for measuring body fat on an individual level can be questioned. A cross-sectional study was conducted among randomly selected 367 female undergraduates residing in hostels of University of Sri Jayewardenepura to determine the relationship between BMI, selected anthropometric parameters and Body Fat percentage (BF%).

Weight, height, mid upper arm circumference (MUAC), mid-thigh circumference (MTC), waist circumference (WC) and hip circumference (HC) were measured in accordance with WHO standards. Total BF% was estimated using Karada Scan®; body fat analyser (Bioelectrical Impedance Analysis). Descriptive statistics, Pearson correlations and Chi-square (χ^2) test were performed in the analysis (SPSS 21.0).

The means of BMI, total BF%, WC, MUAC, MTC, WHR and WTR were, 19.59 ± 3.56 kg/m², 28.23 ± 4.71 %, 72.43 ± 8.92 cm, 25.27 ± 3.69 cm, 43.64 ± 5.42 cm, 0.81 ± 0.07 and 1.67 ± 0.16 respectively. According to WHO categorization for Asians, 41.4 % were underweight (<18.5 kg/m²), 7.9 % were overweight (23.0 - 24.9 kg/m²), 7.6 % were obese (≥25.0 kg/m²). 28.9 % and 7.9 % were with high BF% (30.0 % - 34.9 %) and very high BF% (35.0 % - 50.0 %) respectively. According to WHO cut-off points for anthropometric parameters, 17.4 %, 1.1 %, 9.0 %, 56.4 % and 57.8 % of the study population had a high risk levels for WC (>80.0 cm), MTC (≥60.0 cm), MUAC (>30.5 cm), WHR (>0.80) and WTR (≥1.65) respectively while 39.0 % had under nutrition level for MUAC (<24.0 cm). A significant association was observed between total BF% with BMI, WC, WHR and MUAC (p-value <0.05). A significant correlation was observed between total BF% with BMI, WC, HC, MUAC, MTC, WHR and WTR.

These results highlight that more than half the population is nutritionally abnormal and other anthropometric parameters also show high risk in some of the participants. Dietary interventions and education on nutrition and regular exercises may be necessary for this group of females as they are the future of the country.

Health Sciences

Conflict between intellectual property and public health

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There is a conflict between IP (Intellectual Property) and human rights, especially when it comes to public health. Significantly, there was an essential need to safeguard intellectual property nationwide, and the establishment of National Laws to protect those rights was fundamental. The Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) is one such effort in this respect. It lays down the minimum standards for the fortification of intellectual property rights as well as the process and solutions for their implementation, which are to be implemented by all the members of the W.T.O.

TRIPS agreement came into effect to correspond the measures of public health and IP rights. WTO Ministerial Conference in Doha, 2001 adopted a special Ministerial Declaration to clarify uncertainties between the essential need for governments to apply the principles of public health and the terms of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Concerns had been growing that patent regulations might control access to affordable medicines for residents in developing countries in their determination to regulate diseases of public health, including HIV, tuberculosis and malaria. The Declaration responds to the concerns of developing countries about the difficulties they encountered when looking to implement measures to encourage an approach to affordable medicines in the concern of public health in a wide-range, without limitation to certain diseases. Public health and IP rights only came into a conflict when it concerned the "Patent Rights". Comprehensive requirements have been made in TRIPS with regard to defending the patents.

Owing to this, with the development of IP in the world, public health of the nations was also influenced. Therefore, giving an answer to that and protecting IP rights of the countries TRIPS agreement came into effect. Therefore, in this research paper I would focus on whether the TRIPS agreement is more concerned about IP rights or whether it gives any release to public health in the world.

Comparison of Clinical Disease Activity Index (CDAI) and Disease Activity Score 28 (DAS 28) as composite measures to assess the disease activity in patients with Rheumatoid Arthritis (RA) in Sri Lanka

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Assessment of disease activity in Rheumatoid arthritis is crucial in its management as it helps the physician to assess therapeutic response for prescribed drugs retrospectively and also to decide the prospective treatment adjustments. DAS 28 is a routinely used popular composite tool to assess disease activity in RA globally. But the need of ESR/CRP for its calculation and the complex nature of the calculation have limited its use. CDAI is gaining popularity for disease activity assessment in RA as it depends only on clinical parameters for its calculation. It is not a validated tool for the evaluation of disease activity of RA patients in Sri Lanka. The objective of this study was to investigate the relationship of CDAI and DAS 28 in order to find out whether CDAI can also be used like DAS28 for assessment of disease activity of RA patients in Sri Lanka.

A group of 60 newly diagnosed RA patients attending the rheumatology clinics at the Teaching hospital, Peradeniya and Rehabilitation hospital, Digana were recruited. Baseline disease activity was assessed using DAS 28 score and CDAI. They were started on DMARDs subsequently and reviewed after 9 months at their regular clinic visit to reassess the disease activity using the same tools.

Of the total patients included, the majority were females (n = 53, 88.3%). The age range of the sample was 25-69 years (mean- 51.17 years) and had mean disease duration of 7.7 months. Mean DAS 28 at baseline and at 9 months were 5.93 ± 1.05 and 3.192 ± 1.04 respectively. Mean CDAI at baseline and at 9 months were 27.09 ± 11.04 and 6.8 ± 6.43 respectively. The Pearson's correlation co-efficient showed a statistically significant ($p<0.0001$) correlation between CDAI and DAS 28 at the base line ($r = 0.8640$, figure 1) and at 9 months ($r = 0.8990$, figure 2). There was a "moderate" agreement between the disease activity categories based on DAS 28 and CDAI cut off levels (at first visit- weighted Kappa = 0.511, at 9 months- weighted Kappa= 0.443)

Figure 1

Figure 2
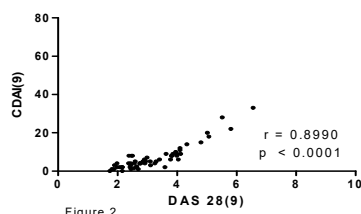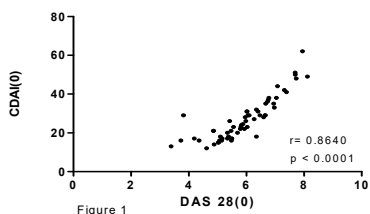
CDAI is a valid and more feasible tool to assess the disease activity in RA patients in Sri Lanka.

Abstract no: 89 (poster)   *Health Sciences*

Awareness on informed consent among residents of Kandy district (A study from Bogahakumbura Division)

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Informed consent is a patient centralized decision making process. During the "Informed Consent Process" a detailed explanation regarding the medical procedure is given to the patient. This is more than simply signing a written consent form. If communication between the medical staff and the patient takes place satisfactorily, then the patient can also participate in making decisions relating to his/her medical care. Patients' interest in participating during the decision making process differs according to various factors such as gender, age and education level. Hence, the objectives of this study were to assess the awareness regarding informed consent in the community and to find out whether the awareness varied depending on gender, age group, and educational level.

A sample of 200 was selected using a random sampling method from the Bogahakumbura Division of Kandy District and a pretested questionnaire was administered. The extracted data based on variables were tabulated using Microsoft Excel spread sheets-2007and analyzed using "JMP Soft Ware-SAS Institute version 6. Chi square test was performed and $P<0.05$ was considered as the level of significance.

All the participants stated that informed consent was obtained by hospital staff prior to an invasive procedure (100%). But a significant difference can be identified, as $P<0.05$ level understands it as a patient right. The level of awareness varied depending on variables. According to this study the difference in the level of awareness between males and females was statistically not significant ($P>0.05$). However, the level of awareness increased with the level of education ($P<0.05$). Also results revealed that young participants were more aware of the informed consent process than the older participants. Awareness declined with participants aged over 58 years ($P<0.05$).

In conclusion, it can be summarized that the level of awareness on informed consent can be affected by education and age. The results of this study can be used to improve the quality of the informed consent process in order to deliver better quality health care with the aim of enhancing patients' safety.

Comparing the effects of general warm up and specific warm up on agility performance of rugby players in University of Peradeniya, Sri Lanka

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Agility is an important skill in Rugby league. The aim of the present study was to compare the effect of general warm up (GWU) and specific warm up (SWU) on agility performance in rugby players.

A convenient sample of twenty four healthy male rugby players from the University of Peradeniya participated in the study. The participants underwent (a) 15 minutes of GWU protocol and (b) 15 minutes of SWU protocol with a recovery interval of one hour. The (a) GWU protocol was: 4 minutes of light jogging, 11 minutes of dynamic stretching and the (b) SWU protocol was: 3 minutes of light jogging, 5 minutes of dynamic stretching, 7 minutes of unplanned agility drills (44s run drill, suicide drill, vertical jump, and step and swear drill). Agility of each player was measured using the Illinois Agility Test.

Results from the Wilcoxon signed rank test demonstrated that both GWU and SWU protocols improved the agility performance (GWU protocol= $p<0.001$, SWU = $p<0.001$), but there was no significant difference between GWU and SWU protocols on agility performance ($p=0.954$). Paired t test results concluded that there was a significant effect on increasing difference of the heart rate of GWU and SWU protocol ($p=0.002$). The mean difference of heart rate of SWU (M=55.12) was higher than the mean difference of the heart rate of GWU (M=47.12). Therefore it was concluded that SWU improves heart rate more than GWU. The Spearman bivariate correlation test result found a positive correlation of height with pre agility score of GWU ($r=0.456$, $n=24$, $p=0.025$), post agility score of GWU ($r=0.445$, $n=24$, $p=0.029$), pre agility score of SWU ($r=0.445$, $n=24$, $p=0.029$) and post agility score of SWU ($r=0.478$, $n=24$, $p=0.018$).

This study found that there was no significant effect of GWU and SWU compared to one another but both GWU and SWU significantly affected agility performance. Furthermore agility of the rugby players has a significant positive correlation with the height of the players. As a result, it was concluded that shorter players have high agility compared with the taller players. Also it was found that weight of the rugby players has a strong positive correlation with their height.

Awareness of women about causes and complications of obesity in Keppitiwalana Grama Niladhari Division

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The rates of being overweight and obese are rising to epidemic proportions, especially among women. Health risks associated with obesity are hypertension, high cholesterol, diabetes, cardiovascular diseases, respiratory problems, musculoskeletal diseases and cancers. This study was designed to find out about the women's awareness about causes and complications of obesity.

A quantitative cross sectional descriptive study was conducted in Keppitiwalana Grama Niladhari division, in Kurunegala district. One woman from each house in the age group of 18 years and above was randomly selected from all 152 houses in that division. A questionnaire was administered to assess the level of awareness. Height and weight were measured and Body Mass Index (BMI) was calculated to assess the nutritional states of women, to categorize them as thin, normal weight, overweight and obese. The collected data was entered and analyzed using Microsoft Excel 2007 and Statistical Package for Social Sciences (SPSS), version 16.0. Chi-squared ($\chi2$) test at $P \leq 0.05$was used to determine the association.

Out of 152 subjects, 36.8% were overweight and obese. Age, education, occupation and standard of living were associated with the level of knowledge. Women aged 60 years and above had a poor level of awareness compared with others. The prevalence of poor level of awareness was higher in persons with elementary education, low standard of living and skilled labors. According to the BMI value, the subjects who are overweight and obese had better awareness than subjects with normal weight. Considering self-perception regarding their body weight, 44.6% of overweight & obese women did not consider them as being overweight or obese.

In conclusion, a considerable proportion of subjects is not aware of the complications and causes of being overweight and do not recognize being overweight as a matter of concern. Also, the subjects with the lowest level of knowledge about the complications of being overweight were elderly females, women with elementary education, skilled laborers and those with low standard of living. A substantial group does not relate being overweight to the diet, lack of exercise or to other major causes of obesity. And the prevalence of misperception as not being overweight was higher among the women with moderate levels of being overweight.

Evaluation of probiotic attributes of *Lactobacillus* species isolated from faecal samples of neonates

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Probiotic Lactobacillus species have preventive as well as therapeutic effects on several types of disease conditions of different etiologies. The objective of this study was to isolate and identify Lactobacillus strains which have probiotic properties, from different faecal samples of healthy one to four days old neonates for the purpose of using them further as prophylactic or therapeutic agents in different disease conditions. Five isolates of Lactobacillus species which are Gram-positive, rod-shaped, non-motile, non-spore forming, and lacking catalase enzyme, were isolated from thirty-five faecal samples. Colony morphology was recorded as differentiated in comparison with Lactobacillus delbrueckii (DSM 20072) on a MRS (de Mann, Rogosa, and Sharpe) agar plate. They were screened, in vitro, for their probiotic potential properties including survival in stomach and bile acidic conditions, the absence of haemolysis and DNase enzyme, resistant to some pathogens and commonly used antibiotics. The results showed that all five isolates were negative to DNase test indicating the absence of DNase enzyme which degrades DNA into nucleic acids, alpha haemolytic (partial haemolysis) when grown in human blood agar, sensitive to commonly found pathogenic strains of *Escherichia coli* (NCTC 10418), *Staphylococcus aureus* (NCTC 6571), *Klebsiella pneumoniae* (An identified clinical isolate), *Pseudomonas aeuruginosa* (NCTC 10662) and *Candida albicans* (ATCC 10231) by disc diffusion method and sensitive to all antibiotics namely, Nalidixic acid (30 μg), Norfloxacin (10 μg), Ciprofloxacin (10 μg) and Ampicillin (10 μg) while only one isolate was resistant to 0.3% bile salts for 3 hours. However, viability decreased with the time and none of them were able to tolerate the acidic condition which was pH at 2.5 even after one hour. Further, it is recommended to identify the isolate strains. In conclusion, the present study showed that none of the isolated *Lactobacillus* species can be used as potential probiotic Lactobacilli.

Relationship of suprascapular neurovascular bundle to suprascapular ligament: a cadaveric study

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The suprascapular nerve usually runs beneath the suprascapular ligament/superior transverse scapular ligament at the suprascapular notch and the spinoglenoid ligament (inferior transverse scapular ligament) at the spinoglenoid notch. However, the location of the artery and vein is highly variable according to literature. The suprascapular nerve arises from the upper trunk of the brachial plexus (C5, C6) whilst the artery usually originates as the first branch of the thyrocervical trunk. The artery and vein join the nerve at the medial half of the superior border of the scapula where variations are described. These variations may lead to decreased space in suprascapular notch. Thus, we conducted a descriptive study to recognize the relationship of the structures in the suprascapular neurovascular bundle to the suprascapular ligament and to classify variations.

34 formalin fixed human cadaveric shoulders in 17 cadavers were used, to dissect the suprascapular region. Here the relationship of the suprascapular nerve, artery and vein to the ligament was noted. The study was carried out in the dissection laboratory of Department of Anatomy, Faculty of Medicine, University of Peradeniya, Sri Lanka in the year 2016.

The relationships were categorized into 5, Type A being artery above the ligament, with vein below (2.94%), Type B where artery and vein ran above (70.58%), type C where both vein and artery ran below (17.64%), type D where vein ran above whilst artery ran below (2.94%) and type E which had two arteries one running above and the other below with a vein running above (5.88%). In all types the nerve ran below the ligament.

Knowledge of the morphological variations of the suprascapular region with regard to the neurovascular bundle is an important consideration during surgical and arthroscopic procedures around the suprascapular notch. It is also important to understand the variations that can induce entrapment of suprascapular nerve. The vulnerability towards entrapment in various morphological types could be further studied using living subjects especially in those involved in violent overhead sports. Thus, the knowledge gained is important during surgical interventions of the region to predict and prevent complications, and also for etiological diagnosis in patients coming with suprascapular neuropathy.

The superficial ulnar artery: an unusual origin and course

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The brachial artery which is the continuation of the axillary artery divides into radial and ulnar branches at the level of the neck of the radius in the cubital fossa. Ulnar artery passes deep to the deep head of pronator teres, fibrous arch of the flexor digitorum superficialis muscle and median nerve. Running medially with ulnar nerve on its ulnar side it enters the palm to continue as the superficial palmar arch. Superficial ulnar artery (SUA) is a rare anatomical variation where the artery runs close to a major vein throughout its course. Therefore, it is at risk of damage during interventions such as venepuncture.

During the routine dissection of an adult male cadaver in the Department of Anatomy, Faculty of Medicine, Peradeniya, an unusual origin and course of ulnar artery was found on the left side. The origin of the SUA was from the 2nd part of axillary artery just proximal to the confluence of medial and lateral roots of the median nerve. It had a course medial to the median nerve immediately underneath the deep fascia and passed onto the forearm above the forearm flexor muscles. Having a superficial course in the forearm closely related to the basilic vein, it came in to the normal position between ulnar nerve and flexor carpi ulnaris tendon at mid forearm level.

According to literature SUA has been described to be arising directly from the axillary or brachial artery. In some instances the brachial artery too adapts a superficial course and gives rise to SUA which is also known as superficial brachioulnar artery.

Variations in the arterial system in extremities are a major clinical concern, especially in surgery, venepuncture and interventional radiology. Accidental arterial cannulations at ventromedial forearm could occur during anaesthesia. Accidental intra-arterial injection of some drugs may lead to gangrene in the distal parts of the limb. Therefore, it is important to understand its occurrence, the types and course of such variations in different populations to prevent such iatrogenic damage which may end up in consequences such as loss of a part of a limb.

Evaluation of patient perception of maternity care in a tertiary hospital

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Antenatal and post-natal care is an important health service which detects and sometimes reduces the risk of complications among pregnant women. The quality of care is likely to influence effective utilization and compliance with interventions.

A descriptive cross sectional study was conducted among mothers admitted in antenatal and post-natal wards in the teaching hospital Peradeniya. Data, collected by self-administered questionnaires, was analyzed by Rstudio software.

According to the study conducted, only 57% of mothers planned their pregnancy and 50% of them got their knowledge on pregnancy through midwives. 59% of mothers were satisfied of the facilities available in our clinic and 85% of mothers had knowledge on indication for their investigations. 79% of mothers knew investigations for fetal complications. 43% of mothers got their knowledge on contraception through antenatal sessions. 66% mothers liked to undergo vaginal delivery and 75% of them preferred participation in decision making. 42% of mothers were satisfied regarding pain management during labor and 70% and 76% of mothers were satisfied regarding attitudes of labour room staff and labour room facilities respectively. 81% of mothers who underwent caesarian section were satisfied on their surgery. Prevalence of satisfaction on post-natal pain management and mental health stabilization was 62% and 66% respectively. 84% of mothers were satisfied on our antenatal and post-natal service as a whole and 86% would like to choose the same hospital in the next delivery.

Our study too reflects a positive correlation between maternity care we provided and their perceptions, just as in previous studies. It was however observed that the level of satisfaction was not always in tandem with willingness to access the services. An earlier survey suggested that women may generally express satisfaction with the quality of antenatal services despite inconsistencies between received care and their expectations of the facilities. This reemphasizes the need for continued audit and evaluation of services at the antenatal clinic by health providers and policy makers.

We conducted this audit on our antenatal and post-natal care services to identify deficiencies in our service delivery. Though overall our results are encouraging, there is still potential to improve our services further.

Knowledge, practices and contributing factors for physical exercise among non-academic staff, University of Peradeniya

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According to WHO, physical exercise is defined as physical activity that is planned, structured and repetitive for the purpose of conditioning any part of the body. Even though it is proven that regular physical exercise reduces the incidence of coronary artery disease, hypertension, type 2 diabetes mellitus, many types of cancers, depression and anxiety, most of the people do not practice regular physical exercise due to multiple factors. The objective of the current study was to determine the knowledge, practices and contributory factors for lack or adequacy of physical exercise among non-academic staff members of the University of Peradeniya.

A cross sectional descriptive study was conducted among non-academic staff members in the eight faculties of the University of Peradeniya. To fulfill the calculated sample size of 422, the subjects were selected randomly from each faculty proportionate to the size. A pre-tested self-administered questionnaire was used for data collection. The type of physical exercise and the duration was considered to determine the adequacy of physical exercise according to WHO standard recommendations.

Total sample studied was 410, with a response rate of 97.2%. Mean age was 38 years. Of them 51.7% (n=212) were males. Only 35.9% (n=147) practiced physical exercise adequately. Involvement in physical exercise was inadequate in 61.2% (n=251), and 2.9% (n=12) did not engage in physical exercise at all. Only 15.1% were able to list more than three types of physical exercises, and 15.1% knew none. Majority of the study population (95.1%) were aware that physical exercise helps in preventing diseases, though only 11.7% knew exercise helps in preventing cancer. The commonest reason for lack of physical exercise was a busy life schedule (61.7%), and 55.4% of the population gave the intention of avoiding risk factors as an encouraging factor for physical exercise. Of the study population only 11.7% (n=48) used the university gymnasium, 5.4% used the swimming pool and 22.7% used the university playground.

A higher percentage of the university's non-academic staff members did not engage in adequate physical exercise. Therefore, it is important to take measures to improve their physical exercise practices.

Palmaris longus muscle: prevalence of absence and morphological variations, a Sri Lankan cadaveric study

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Palmaris longus (PL) is a muscle which originates from the common flexor origin of the forearm as a relatively small fleshy belly which is replaced distally by a long ribbon like tendon. This tendon merges with the palmar aponeurosis and it can be clinically demonstrated by pinching the pads of thumb and little finger together in a flexed wrist (Schaeffer's test). Morphological variations such as reversal of muscle tendon orientation; duplication and triplication; variations in its origin and insertion; and accessory slips are recorded. Nevertheless, the common aberration reported is the unilateral or bilateral absence of PL, which varies among different ethnicities.

Our objective was to find out the prevalence of absence of PL and morphological variations in Sri Lankans by cadaveric dissections.

Thirty two limbs in 9 male and 7 female cadavers were dissected in the Department of Anatomy, Faculty of Medicine, Peradeniya. All cadavers belonged to the Sri Lankan Sinhalese ethnic group. The skin and fascia of the upper limb were reflected. Forearm muscles arising from the common flexor origin and the PL were identified. Attachments, morphology, and variations were verified by careful inspection.

Absences of PL in both forearms were found in one male cadaver (6.25%). One male cadaver (6.25%) had duplication of the muscle on both limbs. The second belly was originating from the common flexor origin medial to PL and developed a similar ribbon like tendon distally which was attached to the volar ligament in front of the wrist.

PL is considered as a vestigial muscle in humans, but it's found to be important for power grip in arboreal primates. In humans it was demonstrated that PL improves gripping among sports personnel who handle racquets and bats, where absence of it may reduce performance. In surgery PL is often used for tendon transplants. The absence of PL is found to be more prevalent among Caucasians and lower incidence found in Mongolians.

Frequency of absence in this study is higher than other Asians and lower than Caucasians. However, it is important to study larger populations and more cadavers to understand its variations and prevalence.

Abstract No: 107 (Poster)   *Health Sciences*

Anatomical variations in the radial artery observed in its origin and course: a cadaveric study

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The radial artery is one of the main two branches of the brachial artery. It usually originates at the level of the head of the radius in the cubital fossa and courses along the forearm deep to the flexor muscles; then crosses the anatomical snuff box where it contributes to the formation of deep palmer arch and sometimes to the superficial palmer arch. Anatomical variations are observed in its origin, course, branching pattern, diameter and mode of termination. The radial artery has been described as a route of transcatheter coronary interventions and a site of arterial blood sampling. Therefore, understanding the occurrence and types of variations related to the anatomy of the radial artery would reduce failure rates of the above procedures and complications associated with them.

During routine dissection, 28 limbs of 14 cadavers were examined for the origin course and branching pattern. Among the 14 cadavers, high origin of the radial artery was observed in two cadavers. One (J10) had a unilateral (left upper limb) variation with an origin on the arm 18cm above the medial epicondyle, whereas, the other cadaver (J4) had a bilateral variation with the origin 17 cm above the medial epicondyle. J10 and J4 radial arteries followed a superficial and deep course respectively. An aberrant artery originating from the second part of the axillary artery, which runs a superficial course, was observed in the left upper limb of one cadaver (J12). In addition to this, the aberrant artery, the normal radial and ulnar arteries were identified at their origin at the level of head of the radius. Out of 28 upper limbs dissected four radial arteries (14.2%) exhibit variations in origin and course or an aberrant artery.

Anatomical variations of the radial artery are relatively common. It has clinically significant implications as the artery is considered one of the best routes for transarterial interventions. There is emerging evidence that imaging the artery for possible variations prior to the procedure can reduce the failure rates.

Survey on knowledge, attitudes and practices on urolithiasis among final year students in the Faculty of Medicine, University of Peradeniya

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Urolithiasis is one of the major problems in urology. Inadequate knowledge, unfavorable attitudes and practices of health care providers' may result in delayed treatment. Therefore, it is important to assess the knowledge, attitudes and practices of urolithiasis among final year medical students to enable planning of health care education programs.

The objective of this study was to determine the knowledge, attitudes and practices on urolithiasis regarding urinary tract stones among final year medical students at the Faculty of Medicine, University of Peradeniya.

This study was a descriptive cross sectional study conducted over a period of three months. Final year medical students were the study population. The questionnaire was administered to 102 final year medical students between the ages of 22 to 28 years. The questionnaire was composed of four parts. The first part assessed demographic data of the students and the number of surgical appointments completed. The second part assessed the level of knowledge regarding urolithiasis. The third part assessed the attitudes towards urolithiasis, while the fourth was concerned with various practices of urolithiasis.

The mean age was 25.21 ±1.04 years. Out of the sample 50.98% (n=52) were males. Their knowledge on risk factors of urolithiasis was poor with a mean knowledge score of 26.18 ±3.13 out of 36.00. Only 20.58% (n=21) had a clear idea about risk factors but 96.08% (n=98) had adequate knowledge about symptoms. Out of the sample 55.55% had positive attitudes towards the urolithiasis. Regarding practice, 90.12% (n= 92) recommended to drink more than 2 liters of water instead of other liquids for patients who suffered from kidney stone disease. Out of the sample 83.35% (n=85) of the participants agreed to advice to avoid high Ca containing food like sprats, milk and cheese, and also to eat more sour sap ('katu anoda').

In conclusion, the knowledge score and practice score were comparatively higher than the score for attitudes which were poor.

Cellular and virological changes with reference to cytopathic effect and virus load in dengue virus co-infections and super-infections *in vitro*

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Dengue virus (DENV) infection is caused by different DENV types: DENV-1, DENV-2, DENV-3 and DENV-4 depending on the prevalence of these types in a particular locale. Since 1960, all four DENV serotypes have been circulating in Sri Lanka and now these DENV types are hyper-endemic. Risk of co- and super-infection is high in a country like Sri Lanka due to the hyper-endemicity of these viruses. There have been a few case reports on DENV co-infections in patients in Sri Lanka. However, experimental studies on co- and super-infections are scanty to understand the virological and cellular changes in co- or super-infections with different DENV serotypes.

Hence, this study was conducted to understand the virological (virus load) and cellular changes (cytopathic effect - CPE) in experimental co- and super-infections with different DENV serotypes in Vero cells. Each DENV serotype was used to infect the Vero cells and incubated for 96 hrs. Cells were observed using the inverted microscope for CPE every 24 hours. After 96 hours of incubation, different DENV was/were harvested along with the Vero cells and the viral RNA was extracted using a validated RNA extraction system (Qiagen, Hilden, Germany). The DENV RNA samples were then subjected to quantitative reverse transcription polymerase chain reaction (qRT-PCR) to determine the viral loads in different infections used for the experiment.

The current study shows that the DENV-2 is an aggressive CPE producer. DENV-1 causes less CPE in Vero cells when compared to DENV-3. DENV-4 does not cause much CPE in Vero cells. DENV-2 has a higher ability to co-infect with other DENV serotypes and it can produce a high number of progeny comparing to other DENV types. DENV-3 takes a longer time to establish and strive in the environment, whereas DENV-1 and DENV-4 are equally competitive and thrive in the environment depending on which serotype infects first. Also the current study findings suggest that a particular DENV infection needs to be present over a period to increase its progeny. When a DENV serotype establishes itself in the experimental environment, the next infecting serotype has to exert pressure to initiate replication.

Pattern of seminal fluid analysis in a population of subfertile men attending the Urology clinic, Teaching Hospital, Peradeniya

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Subfertility is defined as a failure to conceive after one year of regular unprotected sexual intercourse. It is a very common presentation in urological practice. Subfertility affects an estimated 15% of couples throughout the world. Male factors are found to be solely responsible for 20-30% of subfertility cases and contribute to 50% of cases overall. Among the male factors responsible for subfertility hormonal factors, disorders of spermatogenesis and obstructive causes play a major role. Timely and well planned investigations are necessary in the management of subfertility as it has major implications on an individual's life. Seminal fluid analysis plays an important role in the assessment of male subfertility. The objective of the current study was to evaluate seminal fluid analysis findings in a group of subfertile men attending the urology clinic, Teaching Hospital, Peradeniya.

This was a retrospective observational study conducted by the Department of Surgery, Faculty of Medicine, from January 2005 to February 2016. Male patients presented to the urology clinic, Teaching Hospital, Peradeniya with a history of subfertility were included in the study. All the patients' seminal fluid analysis findings were reviewed and the findings were compared with WHO standard reference values.

There were 113 subjects between 24 to 48 years. Mean age was 34.51 ± 5.28 years. Of the study population 86.6% had abnormal seminal fluid analysis findings and 13.3% had normal parameters. 25.7% had a low volume ejaculate while 74.3% had a normal volume of ejaculate. The minimum volume was 0.5ml, the maximum was 5ml with a mean of 2.26 ± 1.14 ml, mean total sperm concentration was $15.61 \pm 33.18 \times 10^6$/ml, mean percentage of progressive motility was 15.94 ± 22.68, and mean percentage for normal forms was 39.65 ± 44.52.

Abnormal sperm characteristics included Azoospermia (44.2%), Oligozoospermia (10.6%) and asthenozoospermia (9.7%). Combined abnormalities included Oligoasthenozoospermia (11.5%) and Oligoasthenoteratozoospermia (8%). Among the occupational groups, skilled agricultural and fishery workers had the highest prevalence of azoospermia (16%).

Seminal fluid analysis plays an important role in assessment of male subfertility. This study shows a higher rate of seminal fluid abnormalities in subfertile patients, of which the commonest was azoospermia.

In vitro evaluation of different surface topography for optimum cellular responses for bone substitutes

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Most of commercially prepared orthopedic prostheses are made of stainless steel, titanium or titanium alloys. However, being a developing country, accessibility of most of these materials are limited due to high cost of both raw materials and processing. Furthermore, the dimensions of most of the implants in the market are not appropriate for local patients. Thus, custom made prostheses have an advantage as the material used can be fashioned into desired dimensions with appropriate surface topography in order to furnish the local requirement. However, the material to be used should possess excellent biocompatibility and biofunctionality where optimum cellular response is one of the major requirements for the success of prostheses.

In the present study, we have used stainless steel (SS) due to their relatively low cost and reasonable corrosion resistance. Samples of 1cm diameter were prepared using SS AISI 316 L, (China) rods and polished using SiC papers (ATLAS, China) with different grit sizes: P100, P200, P600 and P1200, while keeping polishing time (30 min), speed (200 m/min) and the force of the machine (Inc-co Hand held belt sander, China) constant. All the samples were sterilized by gamma irradiation (Co-60, 25 KGy) after heating up to 200 ºC.

The cytotoxicity of SS after introducing different surface micro-structures was assessed by MTT assay and the cellular responses to different surface micro-structures were determined by evaluating cell proliferation, total DNA and total protein content using human osteoblast-like cell line (HOS CRL-1543, ATCC) *in- vitro*. Statistical analysis was done using GraphPad Prism5 (USA) software.

According to the results, samples of SS did not elicit any toxic substance and surface modification has not affected the surface chemistry. The surfaces abraded with P100 and P200 encouraged initial cell proliferation and subsequent cell growth whereas surfaces modified with P600 and P1200 encouraged long term cell proliferation and development while performance of P1200 was better. This preliminary study demonstrates rough surfaces encourage initial osteoblast-like cell proliferation whereas relatively smooth surfaces support long term cell proliferation which warrants further investigation to determine the effects of surface micro-structures on differentiation of cells and bone nodule formation.

Oligoclonal band positive and negative multiple sclerosis: do they represent clinically distinct subgroups of multiple sclerosis?

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The oligoclonal band test is an important investigation which aids diagnosis of Multiple Sclerosis (MS). Isoelectric Focusing (IEF) and immunoblotting is the gold standard method for OCB detection according to current consensus. In a typical western MS population, 95-98% of patients are positive for OCB, reflecting an intrathecal antibody response parallel to the central nervous system inflammatory pathology. A genetic basis for this discrepancy has been reported in a number of studies. OCB positive patients are associated with HLA-DRB1*15 and negative with HLA-DRB1*04, suggesting the possibility of immunogenetically different subgroups that may have a different disease course, and outcome status with varied drug response and possibly prognosis. Therefore, the relationship of OCB status has been studied in relation to clinical presentation and outcome in patients with MS, but still the relationship remains unclear.

Thus, the objective of this study was to compare between OCB positive and negative MS populations in terms of clinical, demographic and investigation findings

Thirty one definite MS patients diagnosed using McDonalds criteria were included in the study. Clinical and MRI features were documented and analyzed to compare between OCB positive and negative groups. All were tested for OCB in both serum and CSF samples.

Of the 31 MS patients, 14 (45.2%) were positive for OCB whereas 17 (54.8%) were negative. Comparison of demographic features (i.e. gender, nationality), clinical subtype frequency (i.e. relapsing- remitting, secondary progressive or primary progressive MS), disease course and disability (EDSS) revealed no significant difference between OCB positive and negative groups. Similarly, comparison of clinical features (i.e. cerebral sensory, cerebral motor, cerebellar, etc.) revealed no significant difference. However, on comparison of MRI features, the presence of cervical cord lesions were significantly higher among the OCB positive group (p<0.01). The rest of the imaging features were not different between groups.

In conclusion, there are no major differences in presentation and clinical course of OCB positive and negative subgroups of MS. Yet, there are some differences seen in MRI findings reflecting an association between MS immunopathology and radiological manifestations of Sri Lankan MS. This might facilitate defining MS subtypes on OCB status with further studies on larger samples.

Attitudes towards complementary and alternative medicine among second year medical, dental nursing and physiotherapy students at the University of Peradeniya, Sri Lanka

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Complementary and Alternative Medicine (CAM) includes a broad range of therapies that fall outside conventional western medicine. With the introduction of western medicine, the usage of CAM has markedly reduced among Sri Lankans. The attitudes of students belonging to the health care professions have a strong impact on the way they ultimately practice medicine. The aim of this study was to assess the attitudes of 2nd year medical, dental, nursing and physiotherapy students of the University of Peradeniya towards CAM.

A self-administered questionnaire consisting of 6 sections; general attitudes, barriers, effectiveness, personal use, sources of information, and importance of evidence to consider CAM was distributed among 317 2nd year medical, dental, nursing and physiotherapy students of the University of Peradeniya at the end of a lecture/meeting. Participation in the survey was voluntary and anonymous. The 15 attitude questions in section one used a 5-point Likert rating scale (5- strongly agree and 1- strongly disagree).

Data was analyzed using Statistical Package for Social Sciences, version 20. The response rate was 91.74%. The composition of the group was as follows: 2nd year dental (18%), medical (61%), physiotherapy (11%) and nursing (10%) students. In this study 64.2 % were females. The majority of nursing students (83.3%) agreed that CAM is useful as a supplementary therapy whereas only 77.8% of dental, 54.6% of medical and 81.9% of physiotherapy students agreed to this. 36.4% of physiotherapy students perceived CAM as a threat to public health. More than 60% of nursing students agreed that CAM should be discouraged unless it is scientifically proven. With respect to the effectiveness of CAM modalities, majority of students agreed that nutritional supplements and meditation were more effective than other modalities such as ayurveda, herbal medicine, and acupuncture. A majority of students (86.9%) used mass media as a source to gather information on CAM. 95.0% of students suggested that a proven mechanism is important for recommendation or usage of CAM therapies. Taken together our study indicates that the students have a neutral attitude towards CAM highlighting the importance of education on CAM for students of health care professions.

Abstract No: 124 (Poster) *Health Sciences*

Prevalence and associated factors of soil-transmitted helminth infections among grade one students of selected government schools in Kandy municipal council area

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Soil-transmitted helminth (STH) infection is a common health problem particularly in young children and adolescents in Sri Lanka. Our aim was to determine the prevalence and associated factors of STH infections among grade one students of selected government schools in the Kandy Municipal Council area.

A cross-sectional survey using 502 students of grade one was carried out in seven randomly selected schools in the above area. A faecal sample was obtained from each student separately and examined microscopically using the concentration technique. A self-administered questionnaire was given to parents to evaluate the factors related to STH infections.

The overall prevalence of helminth infections was 2.4% out of which Ascaris lumbricoides was the commonest infection with a prevalence of 2.3%. Through the analysis of the data it was attempted to determine whether a correlation exists between STH positive group and the factors that were assessed through the questionnaire. Factors including the sex, source of drinking water, food sanitation and food handling methods, monthly income, educational level of parents and most recent antihelmithic treatment were investigated by the given questionnaire from which none of the assessed factors were proven to have a statistically significant correlation with STH infection after analyzing with the chi-square test.

From the results of the study, it is evident that the school-based national deworming program should be further strengthened.

Association between socio-economic status and demographical factors with health related quality of life in patients with Rheumatoid Arthritis attending the Rheumatology clinic of the Colombo South Teaching Hospital

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Rheumatoid arthritis is a chronic inflammatory disease characterized by persistent symmetric inflammation of multiple peripheral joints resulting in a considerable impact on patient's quality of life. The present study was planned to identify the factors which can affect the health related quality of life among the patients with rheumatoid arthritis who are attending the rheumatology clinic of the Colombo South Teaching Hospital. Data were analyzed through SPSS 16.0. Chi square was used to assess the significant association of factors with quality of life and the significant level was kept at $p < 0.05$

A descriptive cross-sectional study was conducted among 307 rheumatoid arthritis patients with the mean age of 58 (SD±10.51) and with a male to female ratio of 1:10. Data related to demographic and socio-economic factors were collected through an interviewer administered questionnaire. SF-36 scale (Short Form Health Survey) was used to assess the health related quality of life

According to the analytical results, monthly income (P=0.007), places where medication was taken (P=0.037), number of children (P=0.005), type of water source used (P=0.050), distance to the water source from the house (P=0.008) and availability of a relative to help with the day to day work (P=0.042) showed statistically significant association with health related quality of life among the study participants.

Demographic factors like age, gender, civil status, ethnicity, religion, and socio-economic factors like educational level, occupation, monthly cost for medications, current residence, type of the family, availability of a stair cases in the house, type of toilet used, distance to the toilet, involvement in the cooking and cleaning activities, mode of washing clothes, availability of a supportive device to walk, distance to the hospital, , availability of a person to come to the hospital and availability of an extra funding system other than salary didn't show significant association with health related quality of life of the study participants ($P > 0.05$).

The results showed that demographic and socioeconomic factors have a significant impact on the health related quality of life of patients with rheumatoid arthritis.

Health Sciences

Unwrapping methods using face recognition and emotion identification

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Face recognition and Emotion Identification have gained increase interest in recent years due to its significant applications. In this research, Face images are converted into signals. This process is called unwrapping. Each of the face is represented as vector with a size of total number of pixels of the face image. Each unwrapped image vectors are represented as row vector. There are four unwrapping methods are used: row wise, column wise, spiral and zigzag method. First, image is unwrapped in row wise and the image matrix is created with the unwrapped images for which Principal Component Analysis (PCA) is applied. Each unwrapped image vectors or signals are represented by the rows of the matrix and size of the signal is given by the number of columns in the matrix. Face recognition is implemented by employing k-nearest neighbor classifier based on the cosine similarity measure. Experiments were conducted on Standard Cohn-Kanade database. Face recognition detection rate is obtained. Then image is unwrapped column wise, spiral and zigzag method and detection rate is obtained using the same procedure in all cases. All unwrapping methods actually produce the identical detection rate. The results show that any unwrapping methods can be used to solve the face recognition and Emotion identification problems.

Efficiency of a hydration plan on hydration level of elite female hockey players

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Dehydration is one of the well-known factors that impair sports performance. It may lead to increased risk of developing thermoregulatory abnormalities. Therefore, consumption of appropriate fluid volumes during outdoor training is important. Good hydration status enhances performance and helps maintain homeostasis of the body. The purpose of this study was to evaluate the effectiveness of a hydration plan on hydration level of female national hockey players in Sri Lanka.

Sixteen elite female hockey players who represent the Sri Lankan national hockey team were selected for the study. A self-administered questionnaire was given to gather the information about awareness of hydration and thermoregulatory abnormalities. Evaluations and examinations were carried out during their daily practice sessions. Pre tests were conducted to assess their baseline hydration levels. Hydration plan was commenced with regular intervals of water breaks and it continued for five days a week for three weeks. A hydration fluid that constituted 6% - 8% carbohydrate and 0.5% NaCl was introduced according to the individuals' fluid requirement to replace their fluid losses. Pretest and post tests were routinely conducted to determine their total body weight loss (fluid loss), fluid intake and urine volumes. Furthermore, urine color was assessed. Fluid consumptions of individuals were measured using calibrated water bottles. Climatic factors such as temperature (WBGT), relative humidity (RH) and wind speed (KmpH) were monitored during the study period.

Within the confines of this study, mean weight loss (fluid loss) among players was less (0.09 ± 0.043Kg) than the pretest amounts (0.12 ± 0.075Kg) and mean fluid intake was significantly increased (0.85L±0.12) than the pretest (0.77L±0.151) ($p=0.000$). Mean sweat loss was lesser (0.12L±0.08) than the pretest amounts (0.68L±0.25) ($p=0.000$). Average sweat rate was higher (0.38 ± 0.072 liters/h) than the pretest (0.31 ± 0.09 liters/h) ($p=0.003$). Urine color observations showed 100% hydrated status of all the players.

The proposed hydration plan significantly improved the hydration status of athletes, which produced an increase in the fluid intake, reduction in sweating and improvement in dehydration status of athletes.

In-vitro and in-vivo hypoglycemic effect of water extract of *Averrhoa carambola L.* (Star fruit)

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Over the past decades there has been a dramatic increase in the prevalence of diabetes and obesity. Hyperglycemia is one of the main factor that affect these health disorders. Recently, literature has emerged indicating star fruit as a tool for managing hyperglycemia. However, its effects on inhibiting carbohydrate digestion have not been properly investigated. The purpose of this research was to investigate the inhibitory effect of water extract (WE) of *A.carambola* on pancreatic alpha amylase activity *in vitro* and hypoglycemic effect of WE *in vivo*.

Fruit juice of *A.carambola* was lyophilized to obtain the WE and it was tested for *in-vitro* α-amylase inhibition using the chromogenic DNSA (3, 5-dinitrosalicylic acid) method, *in-vitro* DPPH free radical scavenging activity and hypoglycemic effect in normoglycemic, male Sprague Dawley rats. In the *in-vivo* long term rodent study, treatment group was orally fed with WE (128 mg/ kg b.w) and the control group was given distilled water. The blood samples were collected from the rats on 0th, 4th and 8th week and analyzed for fasting glucose levels. In addition, preliminary qualitative phytochemical analysis was performed on WE.

The yield of WE was 4.00%. *A.carambola* WE (20.3%) showed moderate *in- vitro* inhibitory effects on α-amylase compared to acarbose (86.7%). Whereas the IC_{50} values of WE was 2.204 ± 0.028 mg/mL. WE exhibited strong DPPH radical scavenging activity with EC_{50} value of 244.2 ± 2.43 µg/mL. Moreover, *in vivo* study showed that 128 mg/ kg dose of WE reduced fasting blood glucose level in treated rats (105.5 mg/dL) compared to control group (126.97 mg/dL) during 8 weeks of the study. Furthermore, presence of alkaloids, flavonoids, phenols and tannins, diterpenes, terpenoids, fats and oils were identified in the extract.

Our *in vitro* study demonstrated an appreciable α-amylase inhibition, hence this may possibly be one of the mechanisms for the hypoglycemic effect exhibited by WE of *A.carambola* in this study. Therefore, these results indicate that water extract of *A.carambola* may be useful in controlling blood glucose level. These findings suggest that the WE of star fruit may be a potential candidate for the search of phytochemicals as potent oral hypoglycemic agents.

Isolation and molecular characterization of *Naegleria* species in water bodies of North-Western province of Sri Lanka

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Free-living amoebae are ubiquitous protozoa that have been isolated from most regions of the world. They are widely distributed in the environment; as such, humans are likely to be frequently exposed to these organisms. *Naegleria, Acanthameba and Balamuthia* have been recognized as opportunistic pathogens of humans and other animals and are known to cause a spectrum of infections.

Although there are several species in this genus, to date, N. fowleri is the only species known to cause human disease. The organism penetrates through the cribriform plate and can cause fulminant and rapidly fatal primary amoebic meningoencephalitis (PAM). The disease is generally acquired while swimming, diving and total submersion for bathing in freshwater-lakes and ponds.

Sri Lanka is a tropical country with large numbers of water bodies which are used by the people for their daily needs. However, there is no systematic study that has been carried out to document the prevalence of these organisms so far.

This study was carried out to isolate *Naegleria* species from water bodies (frequently used by the people) in the North – Western province. Culture and molecular techniques (PCR and DNA sequencing) were done to identify the species. 282 samples from 47 randomly selected freshwater lakes from this region were cultured and examined for trophozoites. Observed all positive growths were tested for enflagellation detected *Naegleria*. All positive growths were tested with the genus specific PCR, and the positive PCRs were sequenced to identify the possible species.

180 samples were positive fortrophozoites. Of those positive samples, 37 samples showed enflagellation. Of these 37 samples, 9 were identified as Naeglaria based ongenus specific PCR assay. PCR sequencing results indicated that the 8 isolates were non-pathogenic *Naegleria* species and only one sample closely correlated to *Naeglaria* fowlerigene sequence. This is the first documentation of pathogenic *Naeglaria* spp, N.fowleri in Sri Lanka.

Edge detection for facial emotion identification

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Identification of emotions have attracted a lot of interest in many applications, especially in the field of medicine, human-computer interaction and gaming. This paper proposes a method of using both the geometric structure information of faces and the image vector obtained by concatenating each row of pixel value of images to form the emotion classifier. Distance based parameters were extracted from each images as geometric information. Parameters such as the length between the eyes, width of the eye, length of the eye, mouth width, and mouth length were selected as features. These parameters were combined to form a geometric descriptor vector for each given image. Image vector was incorporated in the classifier in order to preserve the texture deformations during facial expressions such as appearance of cheek folds during smile. Both geometric descriptor and image vector were used to classify emotions anger, surprise, sad, neutral and smile. The results showed that the emotions surprise, smile and sad were identified correctly whereas anger and neutral were misclassified. Therefore to classify these two emotions correctly the usage of edge detected images was introduced. Edge detection significantly reduces the large amount of data and filters out the unwanted information while preserving the important structural properties. The only major difference between the two emotions anger and neutral are the length between the two eyebrows and deformations near eyes and eyebrows. These differences are captured by the edge detected images. There are a number of edge detection operators such as canny, sobel, prewitt and Robert. Although canny edge operator performs better under noisy situations compared to other edge operators, since our target was to use the edge detection to resolve the ambiguity between anger and neutral, the basic sobel edge operator is used to obtain edge detected images. The results showed that for edge detected images anger was classified with a high detection rate. Hence, by using the geometric descriptor and image vector the emotions surprise, sad and smile were classified, and using edge detected images anger and neutral were classified correctly.

Awareness and practice of ergonomics by dental students in clinical years

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In this study, posture, musculoskeletal disorders and work place layout were investigated under physical ergonomics in a group of dental students, because and dentists and dental students usually use fixed, non-flexible postures and narrow work areas for prolonged periods when assessing and treating patients.

The main tool of this descriptive, qualitative and cross-sectional study was a questionnaire. This study was done among 201 third year and fourth year dental students who were in their clinical practice (30 subjects for pilot study and 171 subjects for original study). Pilot study gathered data on reliability of the questionnaire and necessary adjustment to the final version were made according to the findings. The questionnaire evaluated the presence of pain, areas of body affected by pain, awareness regarding correct postures, work environment, about ergonomics, and preventive measures. The data were analyzed using categorical statistical analysis methods using SPSS 16.0 software, and 95% confidence interval levels were used to describe the findings.

The results of this study indicated that the awareness of ergonomics among dental students was satisfactory, although 96.2% did not know the term 'ergonomics'. Only 5.6% of students reportedly performed stretching exercises after clinical procedures. Students who were in clinical practice the longest (2009/2010 batch) had the most complaints (76.1%) of pain after clinical practice, while the 2010/2011 and 2011/2012 batches complained 54.5% and 72.7% pain respectively. The body areas that most students complained of pain were neck (22.9%), middle back (22.9%) and lower back (22.6%). Periodontal treatment was the procedure that most students (54.3 %) complained to be associated with pain.

The conclusion of the study was that the awareness of ergonomic practices among third year and fourth year dental students was satisfactory. Most of the students did not know the term 'ergonomics' even though they followed good ergonomic practices. The body areas that most students complained of pain were neck, middle back and lower back. The group of students who had been engaged in clinical practice the longest experienced most of pain after clinical practice. Most students reported periodontal treatment as the procedure associated with most pain.

Knowledge and self-foot care practices among diabetic patients, attending the General Hospital, Mannar, Sri Lanka

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Diabetes mellitus (DM) is a chronic progressive metabolic disorder due to lack of insulin or insulin resistance. DM is associated with significant morbidity including foot pathologies such as neuropathy, ulceration and infection. Diabetic foot ulcers (DFU) is preventable but considered the leading cause of lower extremity amputation. Therefore, prevention of lower extremity amputation (LEA) through adequate knowledge and proper self-foot care practices is very essential. The aim of the present study was to assess the knowledge and self-foot care practices among DM patients. This study was an interviewer-administered questionnaire survey which was done among a group of patients attended the diabetic clinic, District Hospital, Mannar. In the present study majority of the patients were females and in the age group of between 60-70 years. Majority of the patients (79.6%) had no adequate educational level while 65.2% of the patients had poor monthly income. Regarding the knowledge on DM and DFU 29.6% and 21.6% of the patients had not known about these conditions, respectively. Majority of the patients (96.8%) had not known about the relationship between DM and DFU. Out of 250 patients only 5 patients (02%) had checked their feet regularly. In addition 77.2% of the patients did not dry their feet after washing whereas 64.8% of the patients did not check their footwear before wearing. Most of the patients (58.8%) had not received health education regarding DM, DFU and self-foot care practice methods. This study sample constituted patients living in rural areas of Mannar. This accounts for the low level of education and income in our study population. Our results are consistent with the other published literature which shows that diabetes patients have a lack of knowledge on the relationship between DM and DFU as well as foot care practices. Our study is the first study which assesses the knowledge and self-foot care practices among diabetes patients, however further studies are necessary to validate these data and for the implementation of programmes to educate the patients regarding DM, DFU and other related pathologies.

Occurrence of Aquaporin 4 receptor antibodies in patients suggestive of Multiple Sclerosis

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Multiple Sclerosis (MS) and other related demyelinating diseases of the central nervous system are in a spectrum. The prognosis, course of the disease and the treatment of each entity are highly variable. Therefore, an early definitive diagnosis is critical. The presence of an objective biomarker: Aquaporin 4 receptor antibody (Anti-AQP4) in serum which is highly specific for Neuromyelitis Optica Spectrum Disorder (NMOSD) aids to exclude seropositive NMOSD from typical MS.

The objective of this study is to determine the occurrence of Anti-AQP4 antibody in a sample of patients, who were tentatively diagnosed as MS.

Eighty one tentatively diagnosed MS patients were included in the study during the period of 2012-2016. Their clinical and paraclinical data were collected and the Anti-AQP4 antibody was tested in the sera using a commercially available validated enzyme-linked immunosorbant assay (ELISA). Then the revised McDonald 2010 and Wingerchuk criteria were applied to categorize them into definite MS, possible MS and NMOSD.

Thirty one patients were classified as definite MS and another thirty one as possible MS. Seven fulfilled the criteria for seropositive NMOSD. Although the clinical features of the remaining twelve patients were suggestive of NMOSD, none of them fulfilled the criteria for a definitive diagnosis. Out of the 31 definitive MS patients, 21 (67.7%), 03 (9.6%), 01 (3.2%) and 06 (19.3%) were classified as relapsing and remitting MS, secondary progressive MS, primary progressive MS and clinically isolated syndrome respectively. Interestingly, 1 out of 31 (3.2%) possible MS patients was positive for Anti-AQP4 antibody. This patient clinically had bilateral optic neuritis with paraclinical features suggestive of MS.

The occurrence of Anti-AQP4 antibodies in Sri Lankan patients suggestive of MS is significantly low reflecting a better initial diagnostic accuracy by the clinicians. However, some NMOSD patients have still been misdiagnosed as MS. This drawback should have been overcome if Anti-AQP4 antibody was tested, especially in borderline MS patients. A significant proportion of Sri Lankan NMOSD patients are positive for Anti-AQP4 antibody which re-confirms its high specificity. Seropositive possible MS patients and the twelve seronegative patients suggestive of NMOSD may require further follow up and neuroimaging studies to arrive at a definitive diagnosis.

Influence of pre-existing cavitations in primary tract stones on success rate of extracorporeal shock wave lithotripsy

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Urinary calculi are one of the most debilitating and painful medical conditions that lead into multiple comorbidities. Treatment modalities of urinary calculi have developed dramatically during the last decades. Currently, Extracorporeal Shock Wave Lithotripsy (ESWL) is the most popular noninvasive treatment modality in clinical practice. The clinical outcome of ESWL depends on a number of factors such as size and chemical composition of the calculi, anatomical location, body habits of patient and type of the ESWL machine. In order to study the influence of other factors involving the clinical outcome, 68 urinary calculi, extracted from different anatomical locations of urinary tract were analyzed.

Cross sectional analysis was carried out by binocular petrographic microscope and crystalline nature of calculi were studied by polarized microscope under plane and crossed polarized light. Selected samples were studied under Scanning Electron Microscope (SEM) for the understanding of micro crystalline materials. The variation of content of organic matter in samples from different anatomical locations was determined using thermo gravimetric analysis.

Present study revealed the increasing of porosity was an important factor for success rate of ESWL but not the micro cavitation within the calculus. Further, it was noted that the content of organic matter influences on the extent of cavitation. Calculi with organic matters can easily undergo biological degradation leaving an air filled cavity behind. When organic matter content is high in calculi, it has higher porosity and higher success rate which is highly fulfilled by pelvicalyceal calculi. In contrast, calculi with high-crystallinity are more stable and therefore, the success rate of ESWL is less. Since the crystallinity of the pelvicalyceal calculi are low, higher success rate of ESWL can be obtained. Bladder calculi that have high crystallinity show higher failure rate of ESWL.

Distribution of bone metastases in prostate carcinoma: isotope (technetium 99m methylene diphosphonate) bone scans in a Sri Lankan population

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Prostate cancer occupies a prominent place among malignant neoplasia of the genitourinary tract, and currently represents the most common neoplasia, being the second most frequent cause of death by cancer in men. Besides PSA, prostatic acid phosphatase, alkaline phosphatase, tumor ploidy, Gleason score, ultrasonography, computed tomography, magnetic resonance imaging, and bone scintigraphy are useful in the work-up of patients with prostate neoplasia. Bone is a preferred and sometimes the only site for prostate cancer metastases, which occur in more than 80% of men with advanced prostate cancer. The objective of current study was to study the characteristics of bone isotope scan findings in the evaluation of bone metastasis in patients with prostate carcinoma.

A retrospective observational study was conducted using 213 subjects at the surgical unit at the Teaching Hospital Peradeniya in combination with the Nuclear Medicine Unit. All patients diagnosed with prostate carcinoma who underwent bone isotope scan for the evaluation of bone metastasis, from January 2009 to June 2016, were included in the study. Each patient's bone scan findings were documented. Analysis was carried out using 20.0 version of the statistical package for the social sciences (SPSS).

The study comprised of 213 patients with a mean age of 68.77 years (SD=8.92). Of the study population 46 % (n=98) of the patients were found to have bone metastasis on isotope scan, and 50.2 % (n=107) did not have bone metastasis on isotope scan, while 3.8 % (n=8) bone scan findings were inconclusive.

Of the sites of bone metastasis the commonest site was vertebrae 83.7% (n=82); pelvis 62.2%(n=61), ribs 59.2%(n=58), sternum 30.6%(30), skull 21.4%(n=21), femur 29.6%(n=29), mandible7.1%(n=7), other sites 19.4%(n=19). Other sites included shoulder joint, tibia, clavicles, knee, scapula, sternoclavicular joint, orbital area, and zygomatic bone.

The commonest site of bone metastasis of prostate origin was the vertebral column.

Gender related differences of clinical, radiological features and oligoclonal band status among Sri Lankan Multiple Sclerosis patients

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Multiple sclerosis (MS) is a chronic inflammatory demyelinating disorder of the central nervous system (CNS) more prevalent in young adults with a wide variety of geographic and ethnic distribution. Similar to other autoimmune diseases, this condition is more prevalent among females. Our objectives were to compare the basic demographic variations, variations in clinical manifestations and investigation findings between male and female MS patients in Sri Lanka.

Thirty one (female/F-18, male/M-13) patients with definite MS diagnosed by revised McDonald criteria 2010 from tertiary care centers of Sri Lanka were selected. An interviewer based questionnaire was used to collect data regarding clinical and investigation findings. Visual Evoked Potentials (VEP) and MRI findings were traced and recorded. Oligoclonal bands (OCB) were tested by isoelectric focusing. Data were analyzed using SPSS, independent sample t test and Fisher's exact test.

The female to male ratio was 1.38:1. The mean ages of onset were F=31.94±3.02 and M=33.23± 3.159 years. The attack frequency per year was F=1.306±0.1573 and M=1.577±0.1776. Mean EDSS were F=3.08±0.158 and M= 3.15±0.468. 83.3% females and 53.8% males had insidious onset of disease. Regarding clinical features, optic neuritis (F-49%, M-77%), sensory manifestations (F-44.4%, M-61.5%), motor (F-61.1%,M-69.2%) , cerebellar manifestations (F-33.3%,M-46.2%), autonomic (F-11.1%,M-7.7%) were observed. VEP positivity was F-66.7% and M-84.6%. Occurrence of relapsing remitting, secondary and primary progressive MS and clinically isolated syndrome was not statistically significant between genders. There was no significant difference of occurrence of MRI lesions in MS typical areas of CNS. The OCB positivity was F-61.1% and M-46.2%; and the difference was not statistically significant between sexes.

Multiple sclerosis is more prevalent among females in the population studied, although the sex ratio is lower than other western based studies. Males apparently have a higher tendency of having eye involvement suggested by both clinical features and VEP results and higher chance of having brainstem involvement suggested by clinical features. Both motor and sensory manifestations are slightly higher in males. Significant percentages from both sexes suffer from sexual dysfunctions. In conclusion, there are no significant differences in demographics, clinical, radiological and neurophysiological features between male and female MS patients in Sri Lanka.

Awareness, need and demand for replacement of missing teeth among partially dentate patients attending a university dental hospital

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Different authors have suggested different methods to evaluate the need for prosthetic management of partially dentate patients. One of the methods for evaluating such includes assessing patients' demand for treatment and objective oral status of patients.

Therefore, our objective was to assess the awareness, need and demand for replacement of missing teeth according to age, gender, ethnicity, educational level, socio-economic status and edentulous space of the patient.

This cross-sectional study (420 patients) was carried out using an interviewer administered questionnaire which assessed the awareness about partially dentate status, attitude and awareness about treatment options available for tooth replacement and the reason for selecting a particular option.

According to the findings that 76.2% of the study group was of the opinion that missing teeth should be replaced by prosthetic means. However, there were no differences with respect to age, gender, ethnicity and educational level.

Although 77.9% and 32.9% were aware of removable prostheses and implants respectively, only 25.2%% knew about tooth supported bridges as an option for replacement of missing teeth. The opinion of patients regarding the need for regular dental visits was statistically significant according to gender and education level. Demand and need for prosthetic management were similar with Kennedy class III.

In conclusion, awareness about reasons for replacement of missing teeth was low in the study group. The awareness about tooth supported bridges and dental implants were low among partially dentate individuals.

The significant association between awareness about treatment options and demand highlights the need for improving public education programmes. Both the demand and need for replacement of missing teeth were high in Kennedy class III partially dentate individuals.

Occurrence of optic neuritis and visual evoked potential characteristics in a group of Multiple Sclerosis patients in Sri Lanka

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Optic neuritis (ON) is a common presentation in multiple sclerosis (MS). Visual evoked potential (VEP) is the main stay of the diagnosis of ON, of which P100 wave is used to measure the rate and amplitude of nerve conduction. Until now there were no studies conducted to determine the degree of P100 wave amplitude and latency and their relationship with occurrence of clinically apparent ON in MS patients in Sri Lanka. The objective of the study was to determine the occurrence of P100 latency delay in eyes with and without optic neuritis, of a group of MS patients.

Study sample consisted of 46 eyes of 23 definite MS patients with VEP reports. Detailed history and a nervous system examination were performed. Patients with following features were categorized as having clinically apparent ON; abrupt deterioration of vision (distant or close) in one or both eyes and/or changes in colour vision with or without ocular or retro orbital pain associated with the visual symptoms and visual symptoms aggravated due to heat. Following examination findings were used to clinically diagnose ON; reduction of visual acuity, impaired colour vision, altitudinal field defects, central scotoma, papillitis and decreased pupillary light reaction.

Details on amplitude and latency of P100 response of VEP reports were recorded in both eyes. P100 responses of all 46 eyes were analyzed with Fishers Exact. Cut off value for P100 wave latency was 103ms.

There were 24 eyes with clinical ON and rest did not. Of the 24 eyes with clinical ON, 20 (83%) had P100 latency delay. Of the 22 eyes with no clinical features of ON, 20 (90%) had P100 latency delay. There were only 2 clinically normal eyes, without P100 latency delay. There was no significant difference of occurrence of P100 wave latency delay in eyes with clinical ON and eyes without clinically apparent ON. Mean P100 response latencies of right and left eyes were 111ms and 108ms respectively. In conclusion, majority of the eyes in this sample of MS patients show P100 latency delay. Interestingly, majority of clinically normal eyes had P100 latency delay indicating the presence of subclinical demyelination.

Congenital renal and urinary tract anomalies in children

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Congenital abnormalities of kidney and urinary tracts (CAKUT) are clinically challenging, because they account for the most cases of paediatric end stage renal disease. If we detect those anomalies, early patients could be benefited from early intervention to reduce morbidity and mortality. Isotope renal imaging plays a major role in diagnosing those abnormalities because it can detect both structural and functional renal abnormalities. The aim of this study is to assess the frequency of congenital renal abnormalities presented to a single unit for isotope imaging.

This study included 646 subjects (421 boys and 225 girls) below 12 years who were presented to Nuclear Medicine Unit, Faculty of Medicine, University of Peradeniya, in the period between January 2015 and June 2016 to undergo renal isotope imaging. Children's clinical records were reviewed to gather information on age, sex and imaging findings.

There were 196 (30.3%) children with congenital kidney and urinary tract anomalies in this study. The most common congenital abnormality detected was vesicoureteric reflux in 67 (10.4%) children. Pelviureteric junction obstruction was detected in 47 (7.3%) and unilateral agenesis of the kidney/single kidney was identified in 28 (4.3%) cases. There were 13 (2 %) children with ectopic kidneys, 19 (3%) children with posterior urethral valves and 14 (2.2%) children with congenital small kidneys/dysplastic kidneys. Horseshoe kidneys were found in 6 (1%) children and mal-positioned and mal-rotated kidneys were found in 2 (0.3%) children.

CAKUT cover a wide range of structural abnormalities which can occur as a part of a syndrome or as an isolated abnormality. This study showed that approximately one third (30.3%) of the children who were investigated for urinary tract diseases were confirmed to have abnormalities in the kidney and urinary tract. Chronic kidney disease is becoming a major health issue in Sri Lanka. Some of these may be resulting from undiagnosed or late intervened CAKUT.

It is important to detect CAKUT to intervene early and to reduce the burden of chronic kidney disease in Sri Lanka.

Denture hygiene and self-reported denture hygiene practices among a group of denture wearers attending a university dental hospital: a pilot study

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The importance of maintaining denture hygiene lies in the fact that they are carriers of multiple potentially harmful microorganisms. The most commonly reported denture associated infection is denture induced *candidosis*. Recent studies have shown that denture hygiene has an effect on the wearer's systemic health. Considering the above facts the aim of the present study was to determine the level of denture hygiene among removable partial denture wearers and their routine hygiene practice.

In this cross sectional pilot study, a self-administered questionnaire which included questions on denture hygiene practice was administered to 120 removable denture wearers. The dentures of each individual were examined by a single observer after using disclosing methods. Denture hygiene was graded into poor, moderate and good. The findings were then statistically analyzed.

Forty five percent of upper dentures and 29% of lower dentures examined showed moderate denture hygiene. Hygiene of both upper and lower dentures did not show significant associations with age, gender and educational level of the patient. However, hygiene and denture age did show a statistically significant positive association. Fifty five percent of the patients cleaned their dentures twice a day. Ninety six percent of the patients used a tooth brush for cleaning dentures. Sixty five percent used soap as the medium. Seventy five percent of the participants had stated that they leave the dentures out at night with 74.2% of them storing them in water. Also there were significant associations between leaving the dentures out at night, medium in which the dentures were kept and denture hygiene level.

In conclusion, majority of the participants had moderate denture hygiene and the level of hygiene had a significant positive association with denture age and leaving dentures out at night.

Health Sciences

Comparison of oligoclonal band numbers of western and Sri Lankan Multiple Sclerosis patients

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Multiple Sclerosis (MS) is a highly heterogeneous disease in terms of clinical and paraclinical aspects, partly attributed to the possible differences in environmental and genetic aetiology. Oligoclonal bands (OCB) are an intrathecal IgG response which can be visualized by isoelectric focusing (IEF) and immunoblotting. OCB has been reported to be important in determining the immunopathology of MS and disease progression.

The objective of this study is to compare the OCB numbers in Western and Sri Lankan MS patients.

Serum and CSF electrophoresis was performed using the horizontal bed electrophoresis system in a pH gradient. The standard IEF protocol followed in Karolinska Hospital, Sweden was adapted to suit our laboratory conditions. OCB positivity or negativity band counts were independently observed and recorded by three trained investigators. Two or more OCBs present in CSF and absent in serum were considered as positive for MS. Statistical significance of the difference of the mean OCB counts was calculated by Unpaired t test using Graph pad prism 5 software.

Statistical analysis confirmed that the mean values of average OCB counts in western positive controls were significantly higher than the Sri Lankan OCB positive MS patients ($P < 0.05$).

Thus, a significant quantitative difference is observed in oligoclonal antibody response between prototypic MS in western and Sri Lankan MS patients. This may have an association to the differences in immunopathology and clinical subtypes of MS in different geographical regions. However, a larger sample is required to further confirm these observations.

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Sub-hepatic vermiform appendix and associated anomalies: a case report

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The vermiform appendix is an out-pouching from the caecum in the shape of a blind ended tube. The position of its base is fixed in relation to the caecum, though the size, shape and direction of the appendix may vary. The commonest position found during surgeries is the retro caecal position. Nevertheless, recent radiological studies suggest a retroileal position as the commonest among all. The caecum is usually found in the right iliac fossa and hence the appendix too is found there. Since appendicitis is one of the commonest scenarios which require surgical intervention, it is important to understand its variations in relation to its position.

During routine dissection of an adult male cadaver in Department of Anatomy, Faculty of Medicine, University of Peradeniya, the caecum was found to be in the right sub hepatic region and the right iliac fossa was empty. The appendix was behind the caecum (retrocaecal) and it was 5.1 cm in length in cephalic direction. The tip of the appendix was located 0.9 cm below the liver and was lying over the right kidney. This was about 2.5 cm away from the ileocecal junction. Further the ascending colon was found to be short, underdeveloped and 1 cm in length.

An abnormal arterial supply too was observed. There was only one artery representing both ileo-colic and right colic arteries which supply the caecum including the appendix and the very short ascending colon. At the distal part of the ascending colon, this artery anastomosed with the middle colic artery that supplied the remaining part of the midgut derivatives

During intrauterine life, failure in elongation of the colon that is returned into the abdominal cavity causes sub hepatic caecum, appendix and short ascending colon. Further this may be the reason for the arterial variation that was observed here. Awareness of such variations is important in the diagnosis and management of situations such as acute appendicitis where surgical intervention is necessary.

Effectiveness of punch skin grafts as a treatment for stable vitiligo: a pilot study

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Vitiligo is a difficult condition to treat. It carries a high psychological impact on people in our country. There are various treatment modalities but none of them are 100% effective. Skin grafting is one of the treatment modalities to treat vitiligo.

Patients with vitiligo who had failed to respond to steroids and azathioprine were recruited for the study.

Informed consent was taken. Punch skin grafts were done to the vitiliginous lesions. All of them were assessed fortnightly for three months. Treatment response was measured with photographic documentation. Four female patients were recruited for the study. The age ranged from 13 years to 60 years. Two had stable segmental vitiligo of the face and two had stable vitiligo over hands and legs. All underwent 4mm punch skin grafts.

At the end of the 3rd month one patient recovered by 90%, two patients recovered by 50% and one patient did not accept the graft at all.

Punch skin graft to the vitiliginous patch can be considered a safe, effective and economical treatment modality to treat treatment resistant stable vitiligo. However, a larger sample size is needed to come to a proper conclusion.

Practices regarding use of insulin among diabetic patients in selected hospitals in Colombo district

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Diabetes mellitus has become a rapidly growing threat and an urgent public health issue all over the world. Due to the key role played by Insulin in managing blood sugar levels, it has become an important part of diabetes treatment. The objective of the study was to assess the practices of Insulin use among diabetic patients which can be used effectively for better glycemic control in diabetic patients in the future.

A cross sectional descriptive study was conducted among diabetes patients aged 18 years and above who were on insulin, attending diabetic or medical clinic in five hospitals in Colombo district. A pretested, interviewer-administered, structured questionnaire was used to collect data.

Out of the total 400 respondents, 78.3% had injected exact amount of Insulin which was prescribed for them. Slightly more than half (51.0%) of the study subjects had shaken their Insulin vial using the pill rolling movement. Nearly half of the respondents (49.5%) had noticed darkness/stiffness or scaring at the site of injection. Among the total study population, the common injection sites were thigh (63.2%) and upper arm (63.0%). The most common equipment used to administer Insulin was vial and syringe (74.0%). The majority of study subjects (88.8%) did not skip meals after injecting insulin. Nearly two thirds of the total participants (65.8%) missed their insulin doses due to different reasons. Among them the most common reason was staying out of home (46.5%) There was a significant association between missing insulin and staying out of the home (p=0.000). Only one fifth of the total population (20.8%) had done exercises and among them 12.5% had done exercises daily, showing that there was a considerable proportion with poor practices i exercising. There is a significant association between education level and patient confidence on self- administration of Insulin (p=0.044).

In some questioned areas practices regarding Insulin therapy can be satisfied. Yet there are areas which need to be further improved. This can be achieved through provision of careful counseling by amalgamation of all healthcare professionals.

A randomized clinical trial comparing the efficacy of decoctions of Rathkaralheba (*Cyathullaprostrata*) and Hathavariya (*Asparagus racemosus*) in the treatment of *Sraviarshas* (bleeding piles)

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In Sri Lanka, Ayurvedic physicians mostly recommend *Rathkaralheba* (*Cyathulaprostrata*) decoction as a common treatment for *Sraviarshas* and they tend to prescribe *Hathavariya* (*Asparagus racemosus*) mostly for bleeding disorders other than *Sraviarshas*. This study was planned to compare the effectiveness of these two medicinal plants in the treatment for *Sraviarshas*.

One hundred patients with bleeding piles were randomly allocated into two groups. Patients of Group R were given *Rathkaralheba* decoction and Group H was given tuber of *Hathavariya* decoction while both groups were given *thriphala* tablets and a sitz bath according to Ayurvedic phenomenon. The duration of the treatment was two weeks. Eight clinical parameters relating to bleeding piles were monitored.

Wilcoxon signed-rank test was used to compare bleeding and pain before and after treatment. In Group R, after treatment scores of bleeding frequency ($Z= -5.976$, $p< 0.001$), bleeding volume ($Z= -5.993$, $p<0.001$), pain frequency ($Z= -4.456$, $p< 0.001$) and pain severity ($Z= -4.462$, $p< 0.001$) were significantly lower than before treatment scores. In group H, after treatment scores of bleeding frequency ($Z= -5.789$, $p< 0.001$), bleeding volume ($Z= -5.725$, $p<0.001$), pain frequency ($Z= -3.830$, $p< 0.001$) and pain severity ($Z= -3.872$, $p< 0.001$) were significantly lower than before treatment scores. The Mann-Whitney test for comparison of two groups showed no significant differences between scores of after treatment in Group R and Group H in bleeding frequency ($Z= -0.826$, $p=0.409$), bleeding volume ($Z= -0.871$, $p=0.384$), pain frequency ($Z= -0.370$, $p=0.712$) and pain severity ($Z= -0.663$, $p=0.508$)

With the results, it can be concluded that both treatment regimens are effective in reducing the symptoms of bleeding and pain of *Sraviarshas* and there was no significant difference of the effect of the two plants. *Rathkaralheba* and *Hathavariya* can be used similarly for the treatment of *Sraviarshas*.

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Cost-benefit analysis of the electronic medical records system in government hospitals in Sri Lanka

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Medical Records (MRs) are a powerful tool that allows the physician to track the patient's medical history and identify problems or patterns that may help to determine the cause of health care and treat patients. Electronic Medical Records (EMRs) are the digital version of the traditional paper base MRs. Currently, the Sri Lankan health care system is piloting an EMR system and a few institutes are using some forms of the EMR system. This study carried out a cost benefit analysis and an opinion study regarding the perception of health care professionals, patients and supporting staff. Two Sri Lankan government hospital Out-Patient Departments (OPDs) were selected. Hospital D has an EMR system and Hospital AR has a traditional paper based recording system. This study calculated the depreciation value for the computers and hardware for the year 2015 and annual costs for usual daily operations for both hospitals for the year 2015. Cost reductions were calculated through comparing both hospitals' costs. Cost reductions were taken as benefits for each hospital relative to the other. Benefits-to-costs ratio was calculated for the year 2015 for the OPDs. Three different questionnaires were distributed separately among Health Care Professionals (HCP), Supporting Staff (SS) and patients. The study found that benefits-to-costs ratio for the year 2015 of OPD of Hospital D was 0.269 and for Hospital AR it was 0.0589. According to the results the benefits for Hospital D relative to Hospital AR were (1) reduction in stationery cost of Rs 61201.36 per month, (2) reduction in patient queue waiting time cost of Rs 192553.82 per month, (3) reduction in supporting staff number Rs 183779.75/month (4) reduction in indirect costs Rs 19851.45/month. The OPD of Hospital D was able to save Rs 5 488 636.58 for the year 2015 because of the EMR system. The opinion study found that patients do not have a thorough knowledge about their previous disease conditions and administered drug regimens. The majority of patients thought MRs are very important for their current and future health care management and to save their time by reducing waiting time at health care institutes. The study found that the average time spending in Hospital D was 50 minutes and in Hospital AR it was 63minutes. Ninety five percent of HCP and 83% of the SS stated that MRs are very important in caring for patients. The majority of HCP and SS agreed to the need of a policy for MRs for Sri Lanka. Poor legibility and misplacing were identified as major problems with traditional paper base MRs for HCP and 91% of HCP suggested EMR as the best solution for them. The majority of patients, HCP and SS though that EMR systems can increase the efficiency of the Sri Lankan health care service. Implementing EMRs sans paper base recording in the Sri Lankan health care system leads to cost reductions. An EMR system only in OPDs of government hospitals can save millions of rupees. If the EMR system is expanded to all units of all hospitals with an inter connection, it may save billions of rupees annually and the Sri Lankan public can have an efficient health care service due to reduction in hospital waiting time.

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Subclavius posticus muscle: clinical significance of a rare supernumerary muscle

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The subclavius posticus (SP) is described either as a variation of subclavius or as an aberrant muscle, extending from the first costochondral junction to the suprascapular ligament or the superior border of the scapula lateral to the insertion of the inferior belly of omohyoid. This muscle, due to its proximity to the neurovascular structures, is considered a potential risk factor for thoracic outlet syndrome, axillary vein thrombosis and suprascapular neuropathy, although its presence is rare.

This study was conducted at the Department of Anatomy, Faculty of Medicine, Peradeniya to find out the presence and the variations of SP.

Seventeen formalin fixed cadavers were examined after removing the clavicle leaving the subclavius intact. Among the thirty-four shoulders dissected, four SP muscles were identified (11.76%). In one cadaver, a muscle originating at the first costochondral junction running dorsolaterally inferior to the clavicle over the axillary neurovascular bundle towards the scapula was noted bilaterally. The distal insertion was the upper border of the scapula and the supraspinatus fascia just lateral to the attachment of omohyoid and medial to suprascapular ligament. The vein proximal to the muscle was grossly dilated with multiple collaterals suggestive of a compressive venopathy. The normal subclavius was absent.

In another cadaver, a supernumerary muscle was noted with normal subclavius, originating at the first costochondral junction, passing below the subclavius over the neurovascular bundle, before inserting to the superior border of the scapula and suprascapular ligament on the right side, and the base of the coracoid process and suprascapular ligament on the left. In both cadavers, the suprascapular nerve passed immediately below the muscle. The supraspinatus and infraspinatus muscles and small muscles of the hand were not atrophied, which would have suggested a suprascapular neuropathy and T1 root compression respectively.

Presence of SP may narrow the cervicoaxillary pathway leading to thoracic outlet syndrome and suprascapular neuropathy. Although evidence of compressive venopathy was present, apparent signs of neuropathy were not found but more objective evidence would be important in excluding it. Both static and dynamic MRI may play a role in diagnosis of neuropathy in the presence of subclavius posticus.

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Effect of micronutrient supplementation during altitude training on haematological and performance parameters of endurance athletes

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The effects of various altitude training models on different parameters in endurance athletes have been studied by many researchers. However, the results of these studies are inconsistent. The present study was carried out to determine whether living at an altitude of 2200 m and training at an altitude of 1800 m for 4 to 5 weeks will have an effect on haematological and performance parameters of endurance athletes and to determine the effect of nutritional supplementation during altitude training on the above parameters.

Long distance male athletes of Sri Lanka Army participating at national level competitions were included in the study. They underwent an altitude training protocol for 30-34 days living at 2200 m and training at 1800 m. Seven subjects were given iron and vitamin supplements (WI group), 6 subjects were not (WOI group). Blood samples were obtained for assessment of haematological parameters, and maximal oxygen consumption (VO_2max) was determined using a submaximal exercise test on the day of ascending to the altitude and within 2 weeks of descending from the altitude.

The mean haemoglobin concentration (Hb) increased significantly only in WI group (p=0.02). The mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration significantly increased in both groups (WI, p=0.008 and 0.001;WOI, p=0.02 and 0.03 respectively), while the mean cell volume significantly increased in only the WOI group (p=0.03). The red cell distribution width (RDW) significantly decreased (p=0.013) in WI and significantly increased in WOI (p=0.046). No significant changes in the serum ferritin level and VO_2max were seen in either group.

Results indicate that Hb increases by 4.2% in endurance athletes with 4-5 weeks of living and training at a moderate altitude when nutritional supplementation is given; and non-supplemented athletes have a tendency to develop an iron deficiency as indicated by increased RDW. Change in VO_2max may not have been observed because the training altitude was higher than the recommended altitude (<1500 m) in a "live high train low" model and, therefore, adequate training intensity could not be maintained.

In conclusion, this study shows that nutritional supplementation is essential for endurance athletes undergoing altitude training to produce a substantial erythropoietic response as well as to prevent development of iron deficiency.

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Relationship between time of onset and the side in ureteric colic

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Ureteric calculi are a commonly encountered clinical problem with a life time risk of 2-5% in the Asian population. Urolithiasis affects up to 2-5% of the Asian population and up to 15% of the population in western countries. Fifty percent of patients have a recurrence of renal colic within 5 years of the first episode. Radiological investigations have a predominant place in evaluating these patients. Urolithiasis is a chronic disease with substantial economic consequences and great public health importance.

This was a descriptive study conducted among patients, who were presented with ureteric colic to the Teaching Hospital, Peradeniya. An interviewer based questionnaire was filled and patients underwent radiological investigations to determine the side of urolithiasis. The purpose of this study was to assess the time of onset of ureteric colic and the side of the stone.

The sample size was 314. In the study sample 29.6% had no demonstrable stone. 43% had it in the right side. 27.1% had it in the left side and 0.3% had bi-lateral ureteric colic. 44.1% of patients had the onset in the morning. 22.8% had the onset in the afternoon. 33.1% had the onset at night.

From the subjects who had stones in the right side 42.1%, 23.5% and 34.4% had the onset of ureteric colic in the morning, in the afternoon and at night respectively. From the subjects who had stones in the left side, 47.4%, 19.2% and 33.4% had the onset of ureteric colic in the morning, in the afternoon and at night respectively.

Right side colic is more common than that of the left side. Ureteric colic had onset commonly in the morning and it is independent of the side. People fasting at night underwent relatively poor hydration which led to concentrated urine. That may be the reason for the highest percentage in the early part of the day.

Sexual dysfunction among male students of the Faculty of Medicine, University of Peradeniya

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Sexual dysfunction is a very common presentation in urology clinics. Although it is very common in elderly men and estimated as 50% of all men, those aged between 40 and 70 have this problem to some degree [1]. Though it is more common among the older age group, 26% of men below 40 years suffer from erectile dysfunction and more than half of them had a severe type [2]. Erectile dysfunction is associated with poor cardiovascular function, ischemic heart disease and stress. Assessment of erectile dysfunction is a way to assess psychological stress and the future risk of ischemic heart disease in a young population.

A cross sectional descriptive study was conducted in the Faculty of Medicine, University of Peradeniya among male subjects. A questionnaire was distributed, and an assessment of sexual dysfunction according to "International Index of Erectile Function (IIEF)" was obtained.

The sample included 232 male medical students with a mean age of 23.49 +/- 1.689 years with a minimum age of 18 years and a maximum of 27 years. All were single. Only 1.3% was circumcised. 3.9% had lower urinary tract symptoms. In the lower urinary tract symptom assessment, no one complained of intermittency, urge incontinence and stress incontinence. Among the subjects 79.3% were sexually active during the previous 4 weeks. This included masturbation as well. Among them 1.7% were homosexuals and 4.7% were bi-sexual.

In this study 2% had erectile dysfunction, 4.36% had orgasmic dysfunction, 6.16% had reduced libido, 3.1% had poor intercourse satisfaction and 9.4% have poor overall satisfaction. Half of them with any disability were severely affected.

In conclusion, among male medical students in Peradeniya, the sexually active percentage is low and sexual disabilities are also lower than in the normal population. The low sexually active percentage was due to lack of free time and places. A condensed time table and the heavy work load as a medical student might be the underlying cause. Medical students had knowledge about physiology and pathophysiology of sexual dysfunction than others. Proper sex education could have reduced anxiety of sex, and it could have been managed without a severe effect.

Antimicrobial activity of piper betel against *Candida albicans* and its effects on adherence to denture acrylic surfaces

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Piper betel is an important medicinal plant with its medicinal properties extending to antimicrobial activity against several pathogenic fungi and bacteria. The objective of this study was to evaluate the efficacy of Piper betel leaf extract against *Candida albicans* adhesion and its biofilm formation on denture acrylics. Young betel leaves (1st-3rd leaf) were subjected to vacuum infiltration with ethanol. Anticandidal activity of a range of concentrations of the leaf extract (5000 - 10000 ppm) was assessed against *C. albicans* (ATCC 90028) and seven laboratory isolates using the agar well bioassay. Further, using a standard biofilm adhesion assay technique, the same concentrations were used to test their ability to suppress the adhesion of *C. albicans* on denture acrylics, as compared to a commercial denture cleanser (positive control), and sterile distilled water (negative control). The results indicated that sterile distilled water had the highest adhesion (23.75±5.3 cells per unit area) while both, the leaf extract of concentrations of 8000 - 10000 ppm and the commercial denture cleanser showed significant ($p < 0.05$) suppression of *C. albicans* adhesion on denture acrylics (less than 1 cell per unit area). There was no significant difference between adhesion in an 8000 ppm concentration extract of P. betel and the commercial denture cleanser of equal concentration, indicating that betel leaf extract is as efficient as the commercial denture cleanser, in suppressing the adhesion and biofilm formation of *C. albicans* on denture acrylic surfaces.

Learning experience of medical laboratory students towards a self-study E-Learning resource: a preliminary study

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E-learning resources have been popularized as a self-learning tool. Acceptance of E-learning resources by students is influenced by several factors including students learning approaches, and quality of the learning resource. This study was aimed to investigate the learning approaches and perception towards E-learning resources of Medical Laboratory Science (MLS) students of University of Peradeniya. MLS students (n=51) who have not been exposed to the series of lectures on histo-techniques were recruited for the study. The Revised Two Factor Study Process questionnaire was used to investigate learning approaches. A pre-test and post-test were conducted before and after delivering the E-learning resource at a computer lab. A questionnaire based on learning experience and attitude towards E-learning resources was administered after studying with the E-learning resource for two hours in the lab. Mean scores for surface approach (SA) and deep approach (DA) were 31.26±6.2 and 23.41±5.9 respectively. The DA score was higher than the SA score for majority of students (78.4%). A significant difference in the mean scores of the pre-test and post-test was observed (p<0.01). Students who showed a greater DA score than the SA score obtained a higher post-test score (73.1±13.0) than students who showed a greater SA score than the DA score (68.9±12.8). However the difference was not statistically significant. The majority of students (98%) agreed with the statement that "the E-learning resource was interesting and it motivated me to study". Many students (67%) disagreed with statement that "the subject matter was boring and I could get more knowledge and better understanding if I read a text book during the same time". The video component was the most interesting part for many students while the most boring part was reading text material. The results indicated that the E-learning resource significantly improved the knowledge of preparation of microscopic slides among students irrespective of the type of learning approaches. Based on the findings, the use of more interactive video and audio material with limited amount of text in self-study material is recommended.

Clinical audit of patients' and operators' experience on root canal treatments done under rubber dam

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Rubber dam has been in use for effective isolation of the root canal and operating field from salivary bacteria. The most frequent arguments against rubber dam are that patients generally do not like it and the prolonged time of treatment. However, according to several studies, the attitude of patients and operators towards rubber dam is rather positive.

The aims of this audit were to record patients' and operators' views of their experience of rubber dam use, to evaluate and compare post-treatment complications and its acceptance by patients.

Information regarding patient and operator experience on rubber dam use in root canal treatment was obtained via a self-administered questionnaire completed by the operating final-year dental students at Faculty of Dental Sciences, University of Peradeniya. The data were evaluated by using SPSS 20.0. Analyses were confined to simple cross-tabulations of the patient's and operator's responses and percentage values for responses were drawn. Rubber dams were placed on 77.8% of the cases excluding 22.2% due to difficulty in placement and practical reasons such as loss of coronal portion of teeth. 65.3% of the patients' attitude was that it was not an unpleasant experience while 34.7% found it as an unpleasant experience. Only 3.57% patients developed any post-treatment complications within two weeks of the procedure while 6.25% of the cases where rubber dam was not placed developed some kind of complications such as pain, swelling, fever, sinus tract and crown fracture. Only 23.6% of the patients have undergone a previous root canal treatment. Of these 75% responded that the previous procedure was not comfortable compared to the current procedure. The patients generally showed a positive attitude towards the rubber dam use and the operator experience was that irrigation with Sodium Hypochlorite during the procedure was rather easy with the aid of the rubber dam. Only a low number of cases developed post-operative complications.

Study on patients' awareness of ischaemic heart disease

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Ischaemic heart disease (IHD) is one of the biggest health burdens in the Sri Lankan population. However, it is a treatable and preventable disease. Achievements of treatment goals are determined through the pharmacological and non-pharmacological management. Patient commitment is important to fulfill the above management strategies. For that, patients' knowledge regarding disease, therapy and lifestyle changes are essential. Therefore, this study was conducted to evaluate patients' knowledge regarding the above aspects, and to find out how a brief education intervention affects patients' awareness of IHD and pharmacotherapy.

Clinically diagnosed IHD patients were randomly divided into three groups and their baseline knowledge on IHD was assessed using a researcher administered questionnaire. Group 1 was treated as the control, and information leaflets were given to groups 2 and 3. Moreover, group 3 had undergone verbal instructions to explain the content of the leaflet. At the end of one month, all the patients' were assessed using the same questionnaire.

Patient's knowledge and awareness with respect to common risk factors of IHD improved in group 2 (22%) and group 3 (42%), after the intervention. No significant improvement in the control group was seen. There was a remarkable rise in the overall awareness regarding their illness after the intervention. In addition, a considerable increase (>10%) in percentage of patients knowing correct drug doses, frequency and names of their routine drugs were noted. Awareness of the use of Glyceryl Trinitrate (GTN) tablets increased markedly in all three groups following the intervention. We observed gaps in knowledge between current practice and what is expected in patients with IHD regarding their pharmacotherapy. Patients' awareness regarding IHD and their drug therapy can be improved using simple education intervention methodologies such as information leaflets and brief verbal counseling.

Exploring perceptions on polypharmacy and drug adverse effects in a sample of post myocardial infarction patients

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Polypharmacy brings-about an imperative concern for patients' safety and it has been linked with increased adverse drug reactions, morbidity and mortality with special reference to patients with multiple comorbidities. This study aims to evaluate the perception and patients' concerns on polypahrmacy ($\geq$ 4 drugs) and drug adverse effects (ADE) in patients who are receiving treatment for myocardial infarction (MI).

A cross sectional descriptive study was conducted at Cardiology unit, Kandy in 2015. Data was collected by interviewer administered questionnaire and by studying patients' health records.

A total of 150 patients (81% males) with a mean age of 60±9 years were studied. The duration following MI ranged from 0.5 to 5 years. The prevalence of polypharmacy was 100%. The mean number of drugs in polymedicated patients was 7.5±1.6. Out of them 52.3% felt that they were taking a large number of medications. However 73% of them were comfortable with the number of medications they were taking and 87% of them were in a view that all their medications were essential. Only 38.3% had a good understanding of the reasons for prescribing each of their medications and 89% of them were willing to stop medications according to physicians' decision without questioning. With respect to drug adverse effects, the prevalence of aspirin associated Gastro-esophageal reflux disease (GORD) was 41%. Major and minor bleeding was observed in 1% and 6% patients respectively. Statin related muscle diseases were observed in 26% and nitrates associated headache was reported by 4.3%. There were 14% of patients who complained of angiotensin converting enzyme inhibitor associated cough.

Prevalence of polyparmacy is high among the post MI population despite having less ADE. Majority is in acceptance of taking many drugs and they are totally dependent on the physician for decision making. Hence, physicians should bear these considerations in mind before each prescription and review all medications used at each visit to avoid unnecessary addictions or hazardous drug interactions.

Abstract No: 228   *Health Sciences*

Impairment of basic activities of daily living of an elderly semi-urban population in Sri Lanka

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Ageing of the population has become a major issue of concern in most South Asian countries. With the aging process, Basic Activities of Daily Living (BADL) seem to be compromised. Therefore, the present study focused on assessing the impairment of BADL of a selected group of elders.

A cross sectional study was conducted on a selected group of elders who attended the Geriatric Clinic at Kadugannawa Base Hospital. The study population contained 516 Sinhala speaking patients. The data was collected using a pre-designed, semi-structured questionnaire. Seven BADL were assessed including getting up from bed, brushing teeth, washing face, bathing, dressing, eating, and toileting.

Out of 516, 159 (30.8%) were males and 357 (69.2%) were females. 45.3% (234), 45.5% (235) and 9.1% (47) were in 60-69 ,70-79 and 80-89 age groups respectively. 95.2% (491) were totally independent on all BADL whereas 4.8% (25) were dependent on one or more. Bathing and washing face were mostly dependent, where 14 (2.7%) of the respondents required assistance for each. Bathing (80%) was most difficult with the ageing process.

BADL impairments were observed in 4.8% of the study population. This lower prevalence could be due to the improvement of general health. Bathing and washing face were the mostly dependent BADL, which could be due to the high demand of physical exertion required by those activities. Bathing was mostly compromised with the ageing, which could be due to the chronic diseases encountered by the elderly that affect their physical energy. The present study concluded that most of the elders were independent on all the BADL while a minority required assistance. Most of the elders were in 60-69 and 70-79 age groups. Thus, the study should be extended to assess the BADL impairment in an advanced age group. We assessed elders who attended the clinic, but there can be elders who were more impaired in BADL within the community. Therefore, the study should be extended to the community, and also assess the Instrumental and Advanced Activities of Daily Living in the elderly population to have a better idea of ageing-related disability in Sri Lanka.

Clinical characteristics of young patients with myocardial infarction: a single center experience

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Although Coronary Artery Disease (CAD) is an uncommon entity in young patients, it constitutes an important problem because of its devastating effect on patients' lifestyle. In addition, these patients may have different risk factor profiles, clinical presentations and prognoses than older patients. This study aims to evaluate the clinical characteristics of young patients with Myocardial Infarction (MI) presented to Teaching Hospital Kandy.

A retrospective cross-sectional study was conducted on patients aged less than 45 years with acute coronary syndrome. The study was conducted from January 2015 to March 2016 at Cardiology Unit Kandy. Data were obtained on demographics, laboratory test results and the treatment adopted.

A total of 100 patients (84% males) with a mean age of 39.84±6.9 years were reviewed. The main risk factors were smoking (53%), Increased LDL [i.e. LDL >100mg/dl] (39%), diabetes (24%), arterial hypertension (19%), and family history of significant CAD (11%). There were 22% who were overweight (Body Mass Index (BMI) 23-25kg/m²) and 32% (BMI ≥25kg/m²) who were obese. There were 55% with inferior, 39% with anterior and 6% with lateral territory involvement. Typical pain was present in 73% of patients and the symptoms onset was as follows: 00:01 to 06:00, 20%, 06:01 to 12:00, 32%; 12:01 to 18:00, 27%; and 18:01 to 24:00, 21%. The study sample showed 6% developing cardiogenic shock and 5% developing arrhythmia following the MI but none developed any mechanical complications of MI. Single vessel disease was seen in 36% patients, whereas 17% had dual vessel disease, 14% had triple vessel disease and 14% had normal coronary arteries. Left main coronary involvement was seen only in 2% of patients.

Most of the young patients had fewer complications following MI. Main risk factors being smoking, lipid disorder and obesity all of which are modifiable which highlights the need for primary prevention in community.

Pattern of coronary artery disease when right coronary artery becomes a non-dominant vessel: a single center angiographic analysis

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In 15% of patients, the Right Coronary Artery (RCA) is said to be "non-dominant" since it does not supply circulation to the inferior portion of the inter-ventricular septum via right posterior descending coronary artery and posterior left ventricular branches. It is interesting to study the pattern of left sided coronary involvement, since in this situation the left system is the main supply to the major part of the heart. Therefore the aim of this study is to identify the pattern of coronary involvement in patients with non-dominate right coronary artery.

A retrospective cross sectional study was performed over the patients who underwent coronary angiography in 2015 January to 2015 December. The coronary anatomy and lesion characteristics were visually analyzed by two separate investigators.

A total of 1531 coronary angiograms was evaluated and 1315 (86%) had RCA dominance, 49 (3%) had a co dominant system and 167 (11%) had left dominant system. Among those who had left dominant system, 9% had LMCA involvement, 53% had Left Anterior Descending (LAD) artery and 29% had Left circumflex (LCX) involvement and 20.4% had both LAD and LCX involvement. There were 22.3% Chronic Total Occlusion (CTO) of the LAD and 10.8% of CTO in the LCX. There were 12% patients having Triple Vessel Disease (TVD) and 34.2% patients having SVD. Occurrence of single vessel disease is statically significant (p=0.001) compared to the occurrence of TVD (12.8 %) in RCA non-dominant patients. The patients who had diabetes mellitus and non-dominant RCA had no statistically significant (p=0.38) diffuse involvement of RCA compared to non-diabetic population. Multi-vessel involvement in diabetic patients (16.3%) compared to non-diabetic patients (16.9%) with non-dominant RCA was not statistically significant (p=0.1).

In patients with dominant left coronary artery system the most frequently involved pattern is SVD with LAD being the most targeted territory.

Abstract No: 234   *Health Sciences*

Pattern of diet, eating habits and Body Mass Index among patients with myocardial infarctions at a younger age

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Life style changes are one of the main determinants of Coronary Artery Disease (CAD) risk of an individual. This study aims to study the pattern of diet, eating habits and body mass index (BMI) in a sample of young patients (age < 45 years) with myocardial infarction.

A retrospective cross-sectional study was conducted on young patients with ST elevation myocardial infarction from January 2015 to March 2016 at Cardiology Unit Kandy. An interviewer administered questionnaire was used for data collection.

A total of 100 patients (84% males) with a mean age of 39.84±6.9 years were reviewed. There were 45% who skipped main meals, 37% took snacks instead of main meals and 56% were regular fast food eaters. There were 60% with high intake of refined starchy food. There were 61%, 68% and 71% who did not intentionally restrict sugar, salt and fat intake respectively and 40% who did not frequently consume fruits and vegetables. Only 16% patients engaged in recreation related physical activity and among them, only 7% had recreation related physical activity level up to World Health Organization (WHO) recommended activity standard. There were 8%, 43%, and 12% who had a Body Mass Index (BMI) of underweight, over weight and obese respectively. Out of the 61% alcohol consumers, 72% consumed alcohol within the WHO recommended units/week but 28% exceeded the recommendation.

A majority exhibited poor dietary habits, irregular dietary patterns and obesity related health issues. Therefore, modification of diet and exercise should be highlighted as major initiatives in primary & secondary prevention of CAD in young.

Comparison of coronary artery disease between young and elderly age groups in Sri Lanka: angiogram based retrospective study

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The risk factors and their relative frequencies vary in between the young and old as the pattern of their coronary artery disease (CAD) and prognosis. To date there is only limited information available on the patterns of CAD in different age groups in Sri Lanka. This study aims to evaluate the pattern of coronary artery involvement by coronary angiography in young (≤45 years) and old patients (>60 years) with CAD.

A retrospective observational study was performed at cardiology unit Teaching Hospital Kandy, recruiting all the cardiac angiographic data in 2015. Coronary angiographic results were individually observed by two examiners. The demographic and risk factor data were obtained from the previous medical records.

A total of 1531 coronary angiograms were reviewed. There were 14.1% patients with CAD who were < 45 years old and 30.6 % patients who were >60 years of age. Prevalence of diabetes was 23% in the younger population, whereas it was 40.4% in the older population. In young patients, single vessel disease (SVD) was seen in 31.6% followed by dual vessel disease (DVD) and triple vessel disease (TVD) occurring in 11.3% and 6.5% respectively. Left anterior descending (LAD) was the commonest vessel involved (16.4%) among those with SVD in the younger population. Among the older patients SVD, DVD and TVD was observed in 30.3%, 28% and 26.7% respectively. In the older population, LAD was again the most frequently (17.1%) affected in those with SVD. Left Main Coronary Artery (LMCA) involvements in younger and older populations were 1.9% and 14.7% respectively. Prevalence of chronic total occlusions in younger and older population was 26.9% and 39.7% respectively.

Prevalence of diabetes is more common in elderly population as well as multi-vessel coronary involvement and chronic total occlusions. The occurrence of SVD shows similar frequencies in the younger and older populations.

Health Sciences

Medico-legal interpretation of casualties presented with physical assault to the Teaching Hospital, Peradeniya

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We explored factors related to assaulted casualties presented to the Teaching Hospital, Peradeniya. The objectives were to identify demographic factors related to casualties; ascertain types of weapons involved; and classify injuries and category of hurt.

Data was collected from medico-legal examinations carried out by the first author from January 2007 to August 2012. Demographic factors, examination findings and circumstances related to the assault were analyzed.

Amongst the 519 assaulted casualties, 400(77.1%) were males and 115 (22.2%) were females. The majority of the casualties (29.9%) were between ages 20-29 years. The mean time of incident was 3:18 p.m. (SD 4.93). Considering the category of hurt, 66% amount to non-grievous injuries, while 31.8% had grievous/endangering life/fatal in ordinary cause of nature. One hundred and sixty two casualties were presented with blunt weapon injuries, while only 17were presented with sharp weapon injuries. Seven (1.7%) were presented with stab injuries. Two hundred and sixty three (50.7%) had abrasions, 249 (48%) had contusions, 155 (29.9%) had lacerations, 64 (12.3%) had cut injuries, 106 (20.4%) had fractures, and only 2 (0.4%) casualties were presented with burn injuries. Thirteen (2.5%) of the casualties had breath smelling of alcohol while 503 (96.9%) of them were not under such influence.

It is a common perception that the rate of violent crime is increasing through the years, but Sri Lanka lacks a database of reported assaults of any sort to analyze the trends; while in other countries it is shown that there is a decrease in this trend. A high proportion of young male casualties that were reported correlate with other similar study results which found that they were most likely to be victims of violence.

Evaluation of self-perceived competencies of intern medical officers in Sri Lanka

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The health care delivery system and the society in a country expect doctors to function with a wide spectrum of competencies. They are expected to achieve these competencies during their undergraduate training. However, as the teaching and assessment in the undergraduate curriculum focuses on knowledge and skills doctors face challenges due to lack of some of the competencies during the internship for first time in their life. Therefore, evaluation of self-perceived competencies among doctors who are planning to work as doctors would be a valuable feedback for medical educators that will highlight important aspects of the curriculum. A 20 item pretested self-reporting questionnaire was administered to a group of 548 doctors from 9 medical faculties in Sri Lanka and doctors graduated from foreign universities at a common meeting held by the Ministry of Health. Responses were analysed according the faculty of graduating and their merit order. More than 50% of doctors from all the medical faculties perceived that their competencies are either above or just meet the expectation of a doctor with regards to knowledge, history taking and examination skills, managing emergencies, non- emergency management of common conditions, procedural skills, written communication skills, solving non-medical problems, communication skills, showing empathy and compassion for patients, showing respect for patients and other health care workers, effective collaboration with the team, interest in non-medical activities, administrative and managerial skills, teaching students, colleagues, and other health workers, research, audit and critical thinking skills, commitment for work, commitment for further learning, acknowledging own limitations and seeks help when appropriate and taking responsibilities according to the role as an intern average. However, competencies with regards to management of emergencies, procedural skills, solving non-medical problems, managerial skills in research, audit, and critical thinking were perceived as low, border line or marginally meet the expectation of a doctor by majority of doctors. Perceptions of doctors from deferent medical faculties revealed unique differences that need specific attention from respective medical faculties. Evaluation of learners' perception highlighted the deficiencies and strengths of the undergraduate curriculum that need attention. However, work place based assessment by the supervising consultant would be a better reflection of competencies of doctors. Repeating the appraisal after a period of working would have been a better indicator, as doctors would have better perception about their competencies by experience. Establishing a system of self-reflection as well as evaluation by supervisors would be helpful to improve competencies of doctors while providing valuable feedback to medical educators.

Association between diabetes mellitus and fasting serum lipid levels along with few selected factors in a rural community in the district of Kandy

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Diabetes mellitus (DM) is a syndrome of chronic hyperglycemia leading to late complications of macro vascular and micro vascular origin. There are 1.5 million deaths every year that can be directly attributed to diabetes. Insulin resistance and type 2 diabetes demonstrate a link with interrelated plasma lipid and lipoprotein abnormalities by increased hepatic secretion and impaired clearance. Therefore, this study was conducted to determine the association between diabetes mellitus and fasting serum lipid levels along with few selected risk factors.

This cross sectional study was carried out using data from an ongoing Non Communicable Diseases (NCD) prevention and control program conducted by the University of Peradeniya. A sample of 168 diagnosed diabetic patients (males=56, females=112) and 402 age and sex matched controls (males=143, females=259) were selected from the database. Cases were defined according to WHO guidelines for diabetes. In females 257 of normal subjects had a mean value of 143.3mg/dl (60.5) for triglyceride and 109 of diagnosed DM subjects had a mean value of 171.9mg/dl (77.1). P = 0.001. Also 259 of normal subjects had an average Body Mass Index (BMI) of 24.4kg/m^2 (4.7) and 112 of diagnosed DM subjects had an average BMI of 25.6 kg/m^2 (4.7). P = 0.03. The mean hip circumference for 259 of normal subjects was 93.4cm (10.2) and for 112 of diagnosed DM subjects was 96.0cm (11.1). P = 0.031.

The findings of this study clearly indicate that diabetes mellitus is significantly associated with increased values of serum triglycerides, BMI and hip circumference in females. However DM is not significantly associated with total cholesterol, HDL, LDL, total cholesterol to LDL ratio, high blood pressure, waist circumference or waist hip ratio in both males and females. Serum triglycerides, BMI, hip circumference, duration of smoking and duration of alcohol consumption are not significant in males.

Association between hypertension and some known risk factors in a rural community in the district of Kandy

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The increasing number of chronic Non-Communicable Diseases (NCDs), threaten the current health care services in Sri Lanka. Among them, hypertension is a commonly heard condition. This cross sectional study was conducted to determine the association of hypertension with fasting serum lipid levels along with fasting blood sugar and a few selected risk factors in a selected rural community in Kandy.

A sample of 247 hypertensive patients (139=males, 234=females) and 373 age and sex matched controls (74=males, 163=females) were selected from the data list of an on-going NCD prevention and control program conducted by the University of Peradeniya. When it came to males, 137 subjects with normal blood pressure had a mean waist circumference of 81.9cm (12.1) whereas 72 subjects with high blood pressure values had mean a waist circumference of 87.8cm (10.0). P =<0.001. When we considered hip circumference, 137 normal subjects had 86.7 (11.0) of average value and 72 elevated blood pressure subjects had an average value of 90.0 (10.2). P = 0.031. In blood sugar levels 142 of normal subjects had 98.4 (18.4) and 72 of diagnosed hypertensive subjects had 115.0 (50.3) corresponding average values. P = 0.009. When the female subjects were taken into account, waist circumference 230 of normal subjects had 81.58cm (12.0) of average value and 160 of diagnosed hypertension subjects had 84.2 (13.8) of average value. P = 0.0043. When we considered the hip circumference, 230 normal subjects had 93.36cm (10.6) of average value and 160 diagnosed hypertensive subjects had an average value of 95.0 (10.2). P = 0.031. In females, the mean of the metabolic equivalence of time (MET) of the non-hypertensive subjects was higher than the hypertensive subjects and the difference was statistically significant which was P = 0.02. However, dyslipidaemia did not show significant association with hypertension.

The findings of this study clearly indicate that there is a significant association between hypertension and waist circumference, hip circumference, waist: hip ratio and blood sugar levels in males whereas in females, hypertension is significantly associated with waist and hip circumference. In females, the level of physical activity demonstrated a statistically significant association with hypertension but it was not so in males.

Comparison of emotional intelligence of two groups of medical students and their co-relations

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Emotional intelligence (EI) is identified as the ability to purposely adapt, shape, and select environments through the use of emotionally relevant processes. A high level of EI is essential in the practice of medicine. Many countries adopt different methods to evaluate the level of EI of students applying for medical courses. However in Sri Lanka students are selected for the medical course purely based on academic merit.

The objective of the study was to compare the level of EI of third and first year medical students of the University of Peradeniya, Sri Lanka and to determine whether there is a significant correlation between EI and gender, student perception of religiousness, their perception of the level of socialization, motivation to study medicine, island rank at GCE A/L examination, number of siblings and the level of family support.

The Genos Emotional Intelligence Assessment Concise Questionnaire, containing seven sub scales was validated and translated for Sri Lanka, was administered to 245 first and third year medical students. The Genos EI raw scores were analysed using SPSS version 22.0.

Hundred and fourteen were male and 130 female, while 185 were first year students and 60 were third years. The mean total EI score for third year students was 106 (range44-138). Mean EI score of first years was 124, (range54-149). The difference between first and third year mean EI scores was statistically significant ($p<0.05$). All the sub categorical scores were significantly lower in third years than in first years.

The difference in the mean EI scores of males and females was not statistically significant ($p=0.345$). Student perception of their religiousness, their perception of the level of socialization, and their motivation to study medicine significantly correlated with EI ($p<0.05$). However, the island rank at GCE A/L examination, number of siblings, and the level of family support did not significantly co-relate with EI.

While EI may be a useful aspect to consider in the selection of students for a medical course, steps need to be taken to ensure enhancement of EI throughout the medical course.

Common health problems perceived by the elders living in elders' homes within Kandy municipal area of Sri Lanka

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There is a rapid growth of the ageing population in Sri Lanka. It has been estimated that the population of the elders will be a quarter of the total population by 2030. One of the main reasons for the rapid increase in the ageing population is increased life expectancy. Due to the complex life patterns, children fail to look after their elders in their own homes. As a result the number of elders in elders' homes is gradually increasing. The study was conducted to describe basic health problems perceived by the elders in elders' homes .A cross sectional descriptive study was conducted using an interviewer administered questionnaire. The Kandy municipal council area was selected where there were four elders' homes consisting of 172residential elders. The total population was selected excluding inmates below 60 years and those unable to communicate.

The mean age of the sample was 76 years. The female percentage was 58%. The majority was Sinhalese (88%), while 11.3% were Tamils. The unmarried percentage was 51%, while 32.7% were widowed. The percentage having children was 36%.One of the main health problems identified was the high prevalence of non-communicable diseases. Out of the diseases studied, 66.7% of the elders were diagnosed for at least one non communicable disease. Common diseases were hypertension (45%) and dyslipidemia (24%). 52% of the elders have not done diagnostic tests for dyslipidemia.The percentage who had age related disabilities was79.3%, and 58.8% out of them did not have the required equipment to overcome them. The percentage who had visitors at least once a year was 66.6% and 46.7%communicate with their families or friends by telephones. More than 95% of the elders were satisfied with food, bathing facilities, and emergency care provided by the institution. The prevalence of non-communicable diseases among the elders living in elders' homes in Kandy was high and diagnostic tests done were not adequate. There were 79.3% who had age related disabilities, while 58.8% of them did not have required facilities to overcome them. However, the most basic facilities provided to the elders were satisfactory.

Abstract No: 283   *Health Sciences*

Comparative analysis of the antioxidant potential of traditional and contemporary betel quids used in Sri Lanka

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Chewing of betel quid has been practiced in Sri Lanka since ancient times. The traditional betel quid (TBQ) chewed by our ancestors consisted of the leaves of Nagavalli variety of betel, clove, nutmeg, mace of nutmeg, cardamom, arecanut, coriander, and ingurupiyali. Over the years the constituents of betel quid has changed and the contemporary betel quid (CBQ) consists of leaves of the Mahamaneru variety of betel, areca nut, tobacco and slaked lime. Chewing of CBQ has been identified as a major risk factor for development of oral cancer. Even though extensive educational campaigns have been conducted to discourage chewing of CBQ, general public is reluctant to give up this habit due to its stimulatory and addictive effects. One strategy to overcome addiction is substitution of the addictive substance with a better substance by highlighting its beneficial effects. One candidate for substitution of CBQ is TBQ. This study was undertaken to comparatively analyze the antioxidant potential of the TBQ and compare it with that of the CBQ.

TBQ and CBQ prepared by mixing equal weights of air dried ingredients were extracted in ethyl acetate and dried by rotary evaporation followed by freeze drying. Dried extracts were dissolved in DMSO and tested for ferric reducing antioxidant power (FRAP) and DPPH radical scavenging activity. Final antioxidant potentials were calculated per gram of the original dry weight of each quid. Analysis of results revealed that TBQ has 6.8 fold higher FRAP (TBQ= 1292.8 ± 39.7 mmol/gram of dry weight; CBQ=189.9 ± 5.8 mmol/gram of dry weight) and 3.3 fold higher DPPH radical scavenging activity (TBQ $IC_{50}=83.52 \pm 1.04$; CBQ $IC_{50}=274.16 \pm 2.36$) when compared to CBQ.

Accordingly, TBQ has a significantly higher antioxidant potential when compared to CBQ *in vitro*. Further studies are in progress to evaluate their antioxidant potentials *in vivo*.

Relationship of internet addiction with depression, loneliness and health related lifestyle among university students

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Internet addiction (IA) is a newly emerged clinical disorder and it has negative effects on physical and mental health. University students are the most vulnerable group for Internet addiction. The aim of the present study was to determine the relationship of IA with Depression, Loneliness and Health related Lifestyle among University students.

Cross-sectional survey was conducted by enrolling 175 students of Faculty of Allied Health Sciences, University of Peradeniya. Internet Addiction Test (IAT) was used to assess the level of IA. Depression, Loneliness, and Health related lifestyle were assessed using Peradeniya Depression Scale (PDS), University of California at Los Angeles (UCLA) Loneliness Scale and Health Practice Score (HPS) respectively. T-test and ANOVA were conducted to examine the differences; and correlation and regression analyses were used to examine the relationships between variables.

Overall, 40.6% of students were placed in IA group. Generally 28.6% of students had mild and 12.0% had moderate addiction. No case of sever IA was seen. There were 20.6% of students in depressive state and 17.1% of students had poor health practice score. The average score that the student got from loneliness scale was 23.42. There was a positive significant correlation between IA and both depression and loneliness. Moreover a negative significant correlation found between IA and health related lifestyle. Male students had higher IA scores than female students. There was a significant effect of purpose of surf internet on IA and a positive correlation between time spent on Internet and IA.

IA was positively correlated with depression, loneliness and time spent on Internet and it negatively correlate with health related lifestyle. Male students are more addicted to Internet than female students. Purpose of surf Internet had significant effect on IA. The results of the study are considered to develop preventive interventions and treatment strategies.

Longitudinal relaxation time analysis of pixel based magnetic resonance imaging parameter for potential acute myeloid leukemia identification

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Acute Myeloid Leukemia (AML) is the second most common hematological tumor around worldwide. Increased activity in bone marrow (BM) in AML patients has been observed over past decades. In this regard, BM magnetic resonance imaging (MRI) enters the arena of non-invasive imaging and become an important imaging modality. Using MRI quantitative determination and analysis of relaxation times enable buildup of novel imaging protocols. Longitudinal Relaxation Times (T1) measurements have been utilized in different previous studies as a prognostic indicator. Therefore, the purpose of our prospective study was to introduce the T1 as a potential *non-invasive* bio-marker for identification of AML patients.

Data for the study was collaboratively obtained using MR images of five adult subjects who have been AML diagnosed at the Oregon Health & Science University, United States of America. A 3D RF (Radio Frequency)-spoiled gradient-echo (SPGR) sequence has been used to acquire coronal T1W-MRI data with variable flip angles (VFA). MATLAB Simulink image processing software was used for the data analysis.T1 values were estimated in pixel by pixel basis within the ROI's (Region of Interest) drawn in L2, L3 and L4 lumbar vertebras on the BM regions in the coronal sections of all five subjects.

The histogram analysis for L2, L3 and L4 in five subjects reveals mean T1 values of 727ms, 784ms and 780ms respectively. Estimated overall mean T1 value within those lumbar vertebras for all five subjects was 762ms.

As reported by Jensen *et al.*, the T1 value of normal subjects is within the 320-602ms. According to our study findings T1 value for diagnosed AML patients carry a considerably high value. The study used only two selected flip angles (FA) and BM data only from L2, L3 and L4. If the number of FA and regions for BM data were increased, uncertainty which can occur due to FA and errors due to area selections can be reduced respectively.

Therefore, this study suggests that T1 of AML patients in BM could potentially be introduced as a diagnostic bio-marker. This study and the method proposed will be explored with more AML patients and will proceed to propose as a *non-invasive* diagnostic bio-marker.

Quality of working length radiographs taken and used by dental postgraduate trainees during endodontic treatment

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Assessment of the precise location of the radiographic apex of a root canal is a necessity for successful endodontic therapy. The universally accepted method of working length (WL) determination is by radiographic means. Radiographs of acceptable quality are crucial for this purpose and proper radiographic techniques should be adopted to achieve maximum diagnostic quality. The purpose of this study was to identify the frequency and type of radiographic errors observed in WL radiographs taken and used by the dental postgraduate trainees.

Intraoral periapical (IOPA) WL radiographs (338) following the bisected angle technique taken by restorative dentistry postgraduates at the first attempt were analyzed using the SPSS statistical software. 196 radiographs were taken using conventional X-ray equipment and were processed using the automatic processor. 132 radiographs were taken using the digital X-ray equipment and radiovisiography (RVG) sensor. These were assessed under standard viewing conditions and 2.5 magnifications.

Each radiograph was analyzed for the presence or absence of technical errors. Analyzed technical errors were improper horizontal angle, improper vertical angle, improper positioning, improper processing and presence of artifacts. Errors resulted were horizontal overlapping, elongations and foreshortening, missing of crown or apex of the tooth, cone cut and presence of fingerprints. Among analyzed WL radiographs, 298 were presented with errors. Errors found were in 162 and 126 radiographs in the conventional and digital systems respectively.

Improper film positioning was the commonest error in both types of radiographs (52.8%) followed by underexposure (19.8%) and elongation (15%). Higher number of errors in conventional radiographs was due to improper fixing (29.4%) and improper contrast (17.3%). Statistically significant differences were observed in radiographs with horizontal overlapping (0.029) and cone cut (0.036). In conventional radiographs significant difference was observed in over-exposed film (0.048).

In conclusion, high number of errors was found in WL radiographs taken by dental postgraduate trainees.

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Ethnic tropism of *Helicobacter pylori* infection towards Tamil ethnicity in a Sri Lankan sample

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Some Helicobacter pylori strains are known to demonstrate ethnic tropism, e.g. East Asians are preferentially affected by more virulent strains, whereas, in the rest of Asia and Africa less virulent strains are more prevalent. We conducted the following study to assess the anti H. pylori IgG prevalence patterns in a cohort of symptomatic patients and asymptomatic volunteers.

A sample of 460 subjects, 241 symptomatic patients and 219 asymptomatic volunteers, residing in the Central Province were recruited. Sample selection was performed in a randomized manner and the investigators were blind to the ethnicity of the participants. Serum anti H. pylori IgG status was assessed by ELISA (Microtech 07BC1051) in venous blood. Fisher's Exact Test and Jonckheere test were used as the statistical tests.

The mean age of the sample was 48.86(SD 14.05) and 246 (53.5%) were males. The ethnic distribution of the sample was 424 (92.2%) Sinhalese, 21 (4.6%) Tamils and 15 (3.2%) Muslims. Among symptomatic patients 9 (3.7%) and asymptomatic volunteers 1 (0.5%) were positive for anti H. pylori IgG. Ethnic distribution of the anti H. pylori IgG sero-prevalence is as follows, Sinhala 4 (0.9%, 4 symptomatic and none among asymptomatic), Tamil 6 (28.6%, 5 symptomatic and 1 asymptomatic) and none among the Muslim ethnic group. The seropositivity (among symptomatic and asymptomatic) across the ethnic groups is statistically significant at 0.05. Post hoc analysis revealed that the ethnic groups Sinhala-Tamil is significantly different. Eight (80%) of the infected were in the 50 to 70 year age group and the rest was in the 30 – 40 year group. There was no significant difference in the sex distribution of the infected individuals. In conclusion, there is a marked predilection of the H. pylori infection towards the Tamil ethnicity, whereas, the prevalence rates among Sinhalese is markedly low. The reason for overall low prevalence of the infection in the sample could be the presence of Sinhala majority in the sample. The infection is predominantly seen in the above 50 year age group.

Career preferences of medical students

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Preferences of present day medical students may reflect ultimate career choices of future medical practitioners. Understanding career preferences and factors which affect these choices are important for the medical educationist in designing educational programs. However, data is sparse in this area.

This study is aimed to describe career preference of final year medical students of University of Peradeniya and factors which influence their preference

A descriptive cross sectional study was conducted on 197 final year medical students, Faculty of Medicine, University of Peradeniya. There were 98 females and 99 males. Data regarding career preference and factors influenced their preference was obtained using a self-administered questionnaire which consisted of both closed and open ended questions. Questions were adopted from previous studies and questionnaire was pretested among 20 pre-intern doctors prior to administration. Data was analyzed using SPSS (Version 20).

The response rate was 81.7%. Eighty two percent (82%) of students wanted to specialize in a particular area. The most popular specialties were Medicine, Surgery, Gynecology & Obstetrics and Paediatrics. Dermatology was also ranked at the top among females. Psychiatry, Anaesthesia, Ophthalmology, Orthopaedic surgery and Emergency Medicine were also considered as second and third preferences. The least preferred specialties included Medical Microbiology, Medical Parasitology, Histopathology, Virology, Radiology and Chemical Pathology. Community Medicine and Medical Administration were also found to be less popular. No student opted for Transfusion Medicine as their first, second or third choice.

Following are the important determinants in choosing a specialty; personal interest (87.9%), enjoying the specialty during the appointment (58.5%), inspiration from role models (53.8%), interesting teaching & learning activity (50.8%) & acceptable working hours (47.7%).

Medicine, Surgery, Gynaecology and Obstetrics and Paediatrics, the subjects with the highest exposure in medical curriculum are the most preferred specialties. Dermatology, Psychiatry, Anaesthesia, Ophthalmology, Orthopaedic Surgery and Emergency Medicine were also among the top preferences indicating interest in these areas. It may be necessary to formulate action plans to encourage students to take up less popular specialties.

Knowledge and attitudes toward patient safety among nursing students at three state universities in Sri Lanka

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A significant number of people are unintentionally injured as a consequence of their treatment through health care systems. Patient safety is about prevention of such errors and adverse effects to the patients seeking medical care. It is a vital component in the quality of nursing care. Nursing students who participate in patient care during their clinical training should develop knowledge and favourable attitudes required for competent practice while ensuring patient safety. This study was aimed at describing knowledge and attitudes toward patient safety among nursing students.

A descriptive cross-sectional survey was conducted among undergraduate nursing students at the Universities of Sri Jayewardenepura, Peradeniya and Ruhuna. The sample consisted of all undergraduate nursing students (N=192) who were in their 2nd, 3rd and 4th academic years of study. A pre-tested, self-administered questionnaire was used. Knowledge was categorized as poor, moderate and good. Data were analyzed using SPSS version 21.

The response rate was 76.8%. Out of 192 participants, 52.1% (100) had a moderate level of knowledge and 47.4% (91) had a good level of knowledge on patient safety. A progressive improvement of knowledge was observed with each academic year. Good knowledge was evident regarding medication safety, prevention of falls and safety during transportation of patients. There were significant associations between sex and knowledge level (p=0.024) and between academic year and the knowledge level (p=0.00).

Knowledge deficiencies were observed on the definitions related to the topic, safety during preparation for IV cannulation, selecting the size of a urinary catheter, collection of a urine sample from an indwelling catheter and the placement of patients. Overall attitudes toward patient safety were positive. Participants had positive attitudes toward ensuring team work, adhering to correct procedures and reporting of errors even when there is no harm to the patient. A majority (46.4%) agreed that making errors is inevitable while 38% agreed on blaming and punishing people who commit errors.

Most of the study participants had good or moderate levels of knowledge and positive attitudes toward patient safety. Deficiencies related to knowledge on invasive patient care procedures and attitudes toward persons who report errors were identified. Improving knowledge and attitudes regarding patient safety among nursing undergraduates will ultimately contribute to enhanced patient care quality.

Physical nature of culture media alters microbial amylase enzyme production

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Microorganisms are of great importance in the production of industrial enzymes, such as amylase, cellulase, protease and lipase. Amylases are the most important enzymes used in Biotechnology. These starch degrading amylolytic enzymes are vital in industries dealing with food, fermentation, textile, paper, pharmaceuticals and sugar. Microbial enzymes are preferred to those from both plant and animal sources because they are cheaper to produce, and their enzyme contents are more predictable, controllable and reliable. Efficacy of microbial enzyme production depends on the nature of the culture media. This study was conducted with the objective of identifying the effect of the physical nature of culture media on microbial amylase production.

One bacterium (Bacillus sp), one fungus (Aspergillussp) and a fungal-bacterial biofilm (FBB) developed from the formers (method of biofilm formation is not revealed due to Intellectual Property Right reasons) were inoculated separately to two physically different culture media (solid and liquid). No microbes were added to the control. The experiment was arranged in a Completely Randomized Design (CRD). Amylase enzyme assays were conducted after 2 and 4 weeks of incubation and surface attachments and biofilm formation of the microbes were observed weekly using a microscope. Data were analyzed by ANOVA and Student's t-test.

Bacillus sp and FBB showed good biofilm formation. The bacterial biofilm significantly improved amylase enzyme production in liquid medium, whereas in solid medium FBB showed the highest enzyme production. According to this study, microbial amylase enzyme production varied with the physical nature of the culture media. Therefore, it is concluded that amylase enzyme production depends on the selection of the physical nature of the culture medium according to industrial requirement. Further studies are however required to understand the effects and potentials of these microbial systems.

Formulation, development and assessment of skin whitening efficacy of whitening cream of *Glycyrrhiza glabra* (LICORICE)

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Skin whitening cosmetics attract an important place in the global cosmetic market. Among them natural skin whitening agents are beneficial due to less toxicity and side effects. Most of the whitening cosmetics are competitive inhibitors of tyrosinase, the key enzyme in melanogenesis. The present study describes the development of effective skin whitening cream using readily available natural ingredients such as virgin coconut oil and distilled water as the base. Tween 80® was used as a surfactant which lowers interfacial tension and prevents the separation of phases. In this study, licorice extracted using methanol was incorporated into stable cream bases. The stability studies of the formulations and skin whitening effect of the extract in terms of tyrosinase inhibitory activity was investigated.

Two stable bases (formulation 1[F1] and formulation 2[F2]) with different ratios of virgin coconut oil (F1-41.2% and F2- 48.6%), Tween 80® (F1-22.3% and F2-24.3%), and distilled water (F1-36.5% and F2-27.1%) were identified and studied based on previous research done at the Department of Pharmacy. Methanolic licorice extract in five different concentrations (1-5% w/w) were incorporated into the selected cream bases. Characterizations such as microscopic analysis, pH and viscosity were measured and stability studies such as visual observations in accelerated temperatures, freeze thaw and centrifugation tests were also conducted.

According to the microscopic analysis, formulated creams were oil in water emulsions. The pH of the formulations varied with the temperature and creams showed higher stability at lower temperature (at 8°C). Viscosities of the creams of F2 containing high virgin coconut oil ratio were greater than the creams of F1 having lower virgin coconut oil content. According to accelerated stability studies at 8°C, all the cream bases of F1 and F2 were stable up to 40 days. Anti-tyrosinase assay for crude extract of licorice showed 81.5% inhibition. This indicated the (*in vitro*) whitening effect of licorice as an effective tyrosinase inhibitor.

Present study has shown that creams kept at 8°C were more stable than the creams kept at the room temperature and 40°C. According to optimization studies of the anti-tyrosinase assay, licorice had higher tyrosinase inhibitory activity and is suitable to be used in skin whitening creams. Further studies are in progress to evaluate the whitening effect of the formulated creams.

Audit on post-operative analgesia in surgical wards in the General Hospital (Teaching), Peradeniya

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Satisfactory post-operative pain management to the expectation of patients is a major challenge for clinicians. Unrelieved acute post-operative pain will lead to many acute deleterious effects as well as neural alterations such as central and peripheral sensitization which can evolve into chronic pain syndromes. Despite efforts to improve post-operative pain management, it remains sub-optimal in many countries.

The primary objective of this study was to assess the adequacy of post-operative pain management in surgical wards of the Teaching Hospital, Peradeniya. The secondary objectives were to assess the pain scores of patients based on current pain management and to assess the feasibility of using Visual Analog Scales (VAS) to assess the post-operative pain in the future.

This observational study was done in surgical wards of the Teaching Hospital, Peradeniya. Eighty two post-operative patients who underwent hernia repair, thyroidectomy, mastectomy or laparotomy were studied. Patients' demographic data, surgical information, pain assessment information and analgesic utilization on the date of surgery and the following two days were collected on a data sheet. Data were analysed to assess the adequacy of post-operative pain management at the Teaching Hospital, Peradeniya.

Approximately 62% of patients had high levels of "pain at rest", while 77% of patients had high levels of "pain on movement" on the day of surgery. The percentage of patients having high "pain on movement" had been reduced to approximately 49% by the following day. There was no significant difference in pain levels according to the drug doses administered, BMI, gender, or the surgery type. The study found that patients had a high incidence of post-operative pain "at rest" and "on movement", on the day of surgery and post-operative day one. It highlights the inadequacy of the current pain management and suggests there is much room for improvement. The study also confirmed that VAS is a useful tool in expressing and documenting severity of post-operative pain.

Gastrointestinal parasites of captive, semi-captive and wild elephants of Sri Lanka

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Parasites can influence the fitness of individuals particularly of small populations of endangered species. Only few studies have examined the gastrointestinal (GI) parasites of Asian and African elephants and there is no published literature available on the GI parasites of elephants in Sri Lanka. A cross sectional, coprological survey of the Sri Lankan elephant *Elephas maximus maximus* was carried out from January to October 2015. Fresh faecal samples from wild, captive and semi-captive elephants were collected and analyzed using a modified salt floatation, Sheather's sucrose floatation, direct iodine smears and sedimentation methods. Species identification was done morphologically. Intensity of parasite infections was determined using the McMaster technique. A total of 85 faecal samples (wild =45; Semi-captive= 20; Captive =20) were analysed of which 58 (68.2%) were positive for GI parasites. Overall, helminth infections (60.0%) were more common compared to the protozoan (37.6%) infections (Chi square test, $\chi^2 = 8.499$; df = 1, $p < 0.001$). A significantly high prevalence of infection was observed in wild elephants (93.3%) compared to semi-captive elephants (55.0%; $\chi2 = 13.516$; df = 1, p < 0.001) and captive elephants (25.0%; $\chi2 =32.289$; df = 1, p < 0.001) but there was no significant difference in the prevalence between captive and semi-captive elephants ($\chi2 =3.750$; df = 1, p = 0.053). Ten types of GI parasites were observed, nine of which were recorded in the wild elephants. Among them the most common infection was *Strongylus* sp. (34.1%) with high intensity (440.1±295.2 EPG). Semi-captive elephants harboured five types of GI parasites while captive elephants had only three types. One captive elephant in the Temple of Tooth was infected with *Anoplocephala* sp. with a low intensity of 50 EPG. In captive elephants protozoan infections were more common than helminth infections which could be due to treatment with antihelminthics. Some of the GI parasites are highly pathogenic such as *Strongylus* sp., *Fasciola* sp. and *Anoplocephala* sp. while others are incidental. It is important to monitor mortalities of these elephants and carry out postmortem examinations to determine whether the cause of death was due to GI infections.

Incidence of dipterans causing myiasis in dogs and cats treated in two veterinary clinics in Peradeniya

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Myiasis, a maggot infestation of wounds in animals, can be classified into three major groups on the predatory behavior of parasites; obligatory, facultative and accidental. For the first time in Sri Lanka, we attempted to examine the relationship between occurrence of myiasis in dogs and cats with the weather pattern (rainfall and humidity). The samples were collected from the Government Veterinary Hospital (GVH), Gatambe and the Veterinary Teaching Hospital (VTH), University of Peradeniya.

Retrospective data were collected using OPD administration books (GVH) and history sheets (VTH) from January to December 2014 and January to September 2014 respectively to check the incidence of myiasis. A total of 119 (GVH) and 180 (VTH) myiasis cases were reported from respective clinics out of which 295 (98.7%) were from dogs and only four (1.3%) were from cats. The number of cases was highest in July 2014, since the temperature and humidity were optimum for the growth of maggots. From March to October, the number of cases kept increasing while the temperature was above 25^0C and humidity was 79-80% except in June. The number of cases decreased from December (records received only from GVH) to February when the temperature fluctuated around 24^0C. There appears to be no clear relationship between myiasis case reports and rainfall. The findings on the positive relationships between myiasis with humidity and temperature, agree well with published information. However, in similar studies the number of cases decreased with increasing rainfall. Therefore further studies are required on the subject.

In a subsequent prospective study conducted during January to September 2015, representative samples of maggots from wounds of dogs and cats from both clinics were collected, preserved and identified morphologically. A total of 51(GVH) and seven (VTH) maggot samples were collected from the respective clinics. A detailed morphological study revealed that all infestations were due to a single species of fly namely *Chrysomya bezziana* (Diptera: Calliphoridae). A majority of reported hosts were males (82.7%) of cross breeds (63.8%) and were between 0-4 years (37.93%). Data generated in this study are confined to dogs and cats. Myiasis is a clinical and surgical complication in livestock, wild and zoo animals as well and a detailed study is needed. It is important that the veterinarians educate pet owners with regard to early recognition of wounds and prompt referral of such affected animals to veterinary clinics to avoid myiasis.

PAPER NOT PRESENTED

Establishment of a PCR based technique for diagnosis of Trichomoniasis in patients attending the sexually transmitted disease and Acquired Immune Deficiency Syndrome control programme in Kandy

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Trichomoniasis is a sexually transmitted disease (STD) in humans. It is caused by a motile pathogenic protozoan, *Trichomonas vaginalis*. This disease is the most common non-viral STD, with an annual incidence of 187 million cases world-wide. Clinical diagnosis of trichomoniasis is not reliable due to nonspecific clinical presentations. Therefore, confirmation of suspected clinical cases by laboratory tests is essential. The diagnosis is usually based on microscopic observation of motile protozoan on wet mount. The sensitivity of this method is low. The sensitivity of polymerase chain reaction (PCR) in the diagnosis of trichomoniasis (97%) is much higher than microscopic examination. However, PCR has not been used as a diagnostic tool in Sri Lanka thus far. Therefore, the present study was carried out to establish a PCR based method to diagnose trichomoniasis in Sri Lanka.

Female patients (age between 15 and 50 years) attending the sexually transmitted disease and acquired immune deficiency syndrome (STD/AIDS) control programme in Kandy were included in the study. Patients' demographic data and clinical status were obtained. Three vaginal swabs were obtained from the posterior fornix of each patient using a sterile Cusco's speculum. Two vaginal swabs were used for wet mount and permanent staining. Other vaginal swab was used to isolate genomic DNA. PCRs were performed using two primer sets, one targeting the internal transcribed spacer (ITS) -1/5.8S/ITS-2 genomic region of the genus *Trichomonas* and second targeting *T. vaginalis* ribosomal DNA (rDNA).

Hundred and fifty one patients were studied during the period from May 2015 to November 2015. Out of these, Majority of patients (87/151) were aged between 15 to 35 years. 97 patients were clinically symptomatic. 19 patients were commercial sex workers. Of 151 samples, three were positive for trichomoniasis by direct smears. All samples were subjected to PCR using the genus and species specific primers. 8 samples were positive for both primer sets confirming the etiological diagnosis as *T. vaginalis*. Interestingly, five cases which were negative for microscopic examination were detected by PCR.

The findings of the study suggest that PCR can be used to diagnose clinically suspected trichomoniasis patients in STD clinics in Sri Lanka.

Chronic anti-inflammatory activity of *Sudarshana* powder on adjuvant-induced arthritis in rats

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Sudarshana powder (SP) is an effective anti-pyretic poly herbal preparation widely used by Ayurveda practitioners. It has 53 ingredients; the main ingredient of the SP is Andrographis paniculata (Burm. f.) Nees in Sri Lanka. The aim of the present study was to evaluate the effect of SP on the progression of adjuvant-induced arthritis in rats.

Arthritis was induced by a single intra-dermal injection of 0.1ml of Freund's Complete Adjuvant (FCA) containing 0.05% w/v Mycobacterium butyricum suspension in sterile paraffin oil into a foot pad of the left hind paw of all groups of Wistar rats. There were four experimental groups. Group I was used as the healthy control group. Group II composed of arthritic rats who received distilled water. Group III was arthritic animals treated with a standard non-steroidal anti-inflammatory drug Celecoxib (5 mg / kg) and Group IV was arthritic animals who received SP (0.5g/kg). Flowing induction of arthritis, daily oral treatment was started on day 14 and continued up to day 28.

Body weight (BW), hind paw ankle joint thickness (AJT) and foot pad thickness (FPT) were measured in all animals using dial calliper on Day 0 (before injection of FCA emulsion) and on Day 3, 7, 10, 14, 17, 21, 24 and 28 after the injection of adjuvant. Full blood count was tested on day 28.

Induction of arthritis significantly increased FPT, AJT and loss of BW. Treatment with SP and standard drug Celecoxib in the arthritic animals produced significant reductions ($p < 0.001$) in FPT, AJT and WBC counts. Further, it also helped in reducing erythema and oedema in the ankle joints and foot pad of the AIA rats and normalized their BW. SP is a scientifically provided traditional rationale in the treatment of arthritis.

Dental morphology of Down's syndrome children and adolescents residing in an institution in Jaffna, Sri Lanka

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Down's syndrome is a genetic condition characterized by an excess chromosome in the 21st pair. By this excessiveness they show several anatomical and physiological anomalies. The main objective of the present study was to investigate the morphological variations in the dentition of children and adolescents with Down's syndrome in an institution in Jaffna, Sri Lanka. We further investigated the sexual dimorphism and bilateral dental asymmetry of metric and non-metric dental features. Twenty six dental casts of Down's syndrome individuals were used. Buccolingual and mesiodistal diameters of teeth of left and right side were measured using digital Venire caliper to the nearest 0.01mm. Fifteen on-metric features were also recorded referring to the Arizona State University (ASU) dental anthropology system. Sexual-dimorphism and bilateral dental asymmetry were analysed by sing SPSS statistical software. Teeth were generally smaller in Down's syndrome individuals than healthy contemporary individuals. Tooth- dimensions were greater in males than females. However, statistically significant differences were observed only in mandibular central incisors, and mandibular first and second molars. They showed higher prevalence of winging 16%), shoveling (30%) and double shoveling (15%) in maxillary central incisors than those of ealthy Sri Lankans. In addition higher prevalence was observed in cusp 5 (95.2%) and cusp of arabelli (80.9%) in maxillary first molar, multiple lingual cusps (89.4%) in mandibular second premolars, hypocone (83.3%) in maxillary second molar and anterior fovea (70%) in mandibular first molar. Deflecting wrinkle in mandibular first molar showed the lowest revalence (5%). Study group showed high bilateral asymmetry in Y-shaped groove pattern, and cusp 6 in mandibular first molar. Bilateral dental asymmetry was higher in metric than non-metric characteristics. Tooth dimensions in Down's syndrome individuals are smaller with minimal sexual dimorphism. Bilateral dental asymmetry in non-metric traits is more common in Down's syndrome individuals than those of healthy contemporary Sri Lankans. Down's syndrome individuals show mixture of sinodont and indodont dental patterns. These variations in the dentition reveals the disturbances occurred during development of the dentition.

Evaluation of odontogenic tumors and cysts diagnosed by Cone Beam Computed Tomography at the University Dental Hospital, Peradeniya

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Cysts and tumors of the jaw bones are commonly encountered lesions in dental practice in Sri Lanka. Even though their presence could be observed in conventional radiographs, accurate details about the lesion cannot be obtained using conventional radiography. Cone Beam Computed Tomography (CBCT) is an advanced imaging modality giving three dimensional images with minimal radiation dose. As it is a new technology in Sri Lanka there are no studies on the use of CBCT to detect cysts and tumors of the jaw bones in Sri Lanka.

A retrospective study was carried out to evaluate odontogenic cysts and tumors diagnosed using CBCT. Radiographic reports of patients referred for CBCT imaging to the Division of Oral Medicine and Radiology, Faculty of Dental Sciences, University of Peradeniya up to 2016 June were reviewed. Cases diagnosed radiologically as possible cysts or tumors were included in the study.

There were 39 such cases and of them 12 were diagnosed as odontogenic cysts and 26 as odontogenic tumors (OT) while one was diagnosed as either a cyst or a tumor. Most of the cases were reported in males (52.5%) and in the age group of 30-40 years. Both odontogenic cysts and tumors had developed on the left side of the angle of the mandible. Nearly 77% of the OT were unilocular lesions and all cysts were unilocular. Most of the odontogenic cyst and OT were uniformly radiolucent, whereas a few lesions were with mixed radiodensity. Just over 80% of OT and 83.3% of cystic lesions appeared as uniform radiolucencies. Most of the cysts showed no relationship with associated oral structures except some cysts which were associated with root resorption. In contrast OT showed a wide array of associations with anatomical structures ranging from displacement of teeth, involvement of inferior alveolar canal, maxillary sinuses and nasal cavity. The commonest OT reported was ameloblastoma.

CBCT is an important radiological technique for the diagnosis and pre-surgical assessment of OT and cysts. It helps in clear visualization of lesions with nearby anatomical structures which is important in the management of such lesions.

Abstract No: 348 (Poster)   *Health Sciences*

Native valve endocarditis: a case report

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Infective endocarditis is a challenging diagnosis which is comparatively more common in developing countries. Without treatment the mortality approaches 100% and even with treatment there is a significant morbidity and mortality.

The case presented here is of a 43 year old male who was found to have mild aortic valvular disease 6 months back. He presented with a 3 week history of fever, drenching night sweats and multiple large joint pain. On admission he had an early diastolic murmur and splenomegaly. Investigations confirmed the diagnosis of bacterial endocarditis. He was managed with IV antibiotics (C. penicillin and Gentamicin). Even though he was improved clinically, the following discharge he presented again with a 2D-echocardiogram report revealed the persistent vegetation. He was then started on IV gentamicin and ceftriaxone which contributed to improvement of his condition.

Appropriate management and close monitoring until full recovery is essential in patients with infective endocarditis in order to prevent serious complications such as congestive heart failure, periannular abscesses, myocardial infarction, and systemic embolization. Even after these patients improve and recover clinically, the vegetation might persist as in the case of our patient. This highlights the necessity of taking follow-up action with investigations in patients diagnosed with infective endocarditis.

Depression among head and neck cancer patients treated with chemoradiation

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Patients with head and neck cancer are prone to psychosocial problems because social interaction and emotional expression depend to a great extent upon the structural and functional integrity of the head and neck region. The objective of this study was to evaluate the changes in the level of depression in patients with head and neck cancer undergoing chemo radiation.

A prospective analytical study was conducted at a tertiary care center and consecutive patients having histopathologically confirmed squamous cell carcinoma of head and neck region who were prescribed chemoradiation were included. Socio-demographic and clinical data were recorded. Validated Sinhala and Indian Tamil versions of the Center for Epidemiological Studies Depression scale (CES-D) were administered on three occasions; before the commencement of chemoradiation, at the end of the chemoradiation cycle (at six weeks from baseline) and at three month from baseline. Demographic characteristics were summarized by descriptive statistics. Changes in the level of depression were compared on three occasions with repeated measures ANOVA. A cut-off score of 16 or greater was considered as risk for clinical depression.

Of the 47 patients, 66% showed risk of clinical depression at baseline and 23.4% after six weeks. However at three months after baseline risk of clinical depression was evident in all patients (100%). The level of depression had significantly reduced at six weeks (12.61±4.87), compared to baseline (19.14±8.38, P=0.001). However the level of depression had significantly increased three months following treatment (32.61±4.87, P=0.001). The initial reduction could be due to high levels of attention and positive attitudes towards treatment. The later rise could be due to complications associated with treatments such as fatigue, body weakness, hair loss and oral ulcerations. The results of the study indicate the need for attention of complications due to treatment and also psychological evaluation of patients

Changes in health related quality of life in head and neck cancer patients treated with chemoradiation

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The objective of this study was to evaluate the changes in health related quality of life (HRQOL) in patients with head and neck cancer undergoing chemoradiation.

A prospective analytical study was conducted at a tertiary care center using a convenience consecutive sample of patients having histopathologically confirmed squamous cell carcinoma of head and neck region and who were prescribed chemoradiation. Socio-demographic and clinical data were recorded. European organization for research and treatment of cancer quality of life questionnaire (EORTC QLQ C30) and head and neck specific questionnaire (EORTC H&N 35) were administered on three occasions; baseline (immediately before the commencement of chemoradiation), six-weeks from baseline (at the end of the chemoradiation cycle) and after three-months from baseline. Demographic characteristics were summarized using descriptive statistics. Changes in HRQOL were compared on the three occasions with repeated measures ANOVA.

A total of 47 patients (37 males and 10 females) were recruited and their mean age was 58.7 ± 10.9 years. Compared to the pre-treatment level of overall HRQOL (672.6 ± 91.9), the overall HRQOL significantly decreased at six weeks (600.80 ± 48.80, $P=0.008$) and three months (627.5 ± 62.89, $P=0.001$) but the score increased significantly at 3 months compared to six weeks ($P=0.001$). Although the global health status showed an improvement, it was not significant (64.7 ± 23.1, 68.4 ± 18.8 and 69.3 ± 15.8). The functional scale significantly increased at six weeks (422.2 ± 9.5, $P=0.04$) and decreased at 3 months (375.3 ± 57.2, $P>0.05$) compared to baseline (410.9 ± 13.5). The symptom scale decreased at 6 weeks (110.2 ± 79.2) and 3 months (182.9 ± 98.9) compared to baseline (197.0 ± 18.9). However, it increased significantly at 3 months compared to 6-weeks ($P=0.001$).

In general, the improvement in HRQOL of patients suggests that the use of chemoradiation as a primary treatment for head and neck cancer patients is beneficial. The significant deterioration of functional and symptom domains suggest the need to control side effects of chemoradiation. It is recommended that long term changes (at least for 6 to12 months) in HRQOL in this group of patients be evaluated further.

Health Sciences

Assessment of demography and common clinical symptoms among hypertensive patients in Sri Lanka

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Hypertension is responsible for a great proportion of morbidity and mortality among young adults throughout the world. It is known as the silent killer as often it is asymptomatic. However, there are some symptoms patients tend to ignore but may suggest a diagnosis of hypertension. Therefore assessing the prevalence of those symptoms among hypertensive patients along with their demography is vital to improve patients and public awareness and early detection of hypertension. The aim of this study was to assess the prevalence of major symptoms i.e. the symptoms which patients may find most disturbing or caused them to seek medical attention and minor symptoms i.e. the symptoms which patients may have ignored in the past. This study was conducted at the Teaching Hospital Peradeniya, Sri Lanka involving 371 chronic hypertensive patients who were followed up in medical wards and hypertension clinics.

From the total of 371 patients 68.2% were females and 58.2% were in 61-80 age group. Mean age of the population was 64.57. 91.6% and 91.9% were Sinhalese and Buddhists respectively. 67.1% were married and 28.8% were widowed. Mean age at 1st detection of hypertension was 57.1. Considering the total population dizziness was the most prevalent major symptom (30%) followed by headache (16%) and chest pain (15.5%). 21.2% had no symptoms. Headache was the most prevalent minor symptom (59.29%) followed by chest pain (40.9%) and dizziness (39.8%). There was no significant difference with regard to gender in major symptoms however headache in female and chest pain among male as minor symptoms were significantly prevalent from the opposite gender(P-value=0.04,0.036).

In conclusion, dizziness, chest pain and headache are frequent symptoms among hypertensive patients and therefore those symptoms can be used as screening questions to detect hypertension in early stages and there by prevent serious complications of hypertension.

Heenbowitiya (*Osbeckiaoctandra*) prevents carbon tetrachloride (CCl₄)-induced liver injury in ICR mice

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Liver is one of the most vital organs that functions in metabolism and detoxification of substances absorbed in the body. Hepatocyte has high metabolic rate, and therefore the liver is more prone for injury caused by chemicals or infectious agents that lead to alter the liver metabolic functions, which results in liver fibrosis and subsequent liver failure. In western medicine, treatments for reversing liver injury and liver diseases are limited. Alternatively, there is a higher demand at present for traditional herbal medicines which were used for over thousands of years. HeenBoviiya (*Osbeckiaoctandra*) is an endemic plant of Sri Lanka, and considered to have certain medicinal value against liver diseases. Present study was conducted to evaluate the hepatoprotective effect of leaf preparation of *O.octandra* on carbon tetrachloride (CCl4) induced liver fibrosis in ICR mice. Four-month old, sixty male ICR mice were divided in to four groups and group 1 was given Leaves Preparation (LP) only (0.5g DM/Kg BW, orally), group 2 was given CCl4 only (1 ml/kg BW, intraperitoneally), group 3 was given LP (0.5g DM/Kg BW, orally) and CCl4 (1 ml/kg BW, intraperitoneally). Group 4 (control group) was only given equal amounts of distilled water, orally. All treatments were carried out twice aweek for 8 weeks. Body weight was measured once a week during the experimental period. Liver weight and liver samples were taken at 2, 4, 6 and 8 weeks after the experiment periods and histopathological examination was performed in the formalin fixed liver tissues. The livers from CCl4 treated group showed severe hepatocyte damage and fibrosis-indication in liver injury. However, livers of the animals treated with CCl4 and LP treatments showed normal hepatic architecture similar to control group. Thus, the present data suggest that *O.octandra* LP has a protective effect against CCl4-induced liver injury in mice advocating therapeutic use of *O.octandrain* liver diseases.

Audit of current pattern of practice in prescribing medications for hypertensive patients in Sri Lanka

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Antihypertensives cost a major fraction of our heath budget as hypertension is one of the most prevalent chronic illnesses and therefore it is important to enquire about the current pattern of starting and continuation of antihypertensive to optimize the disease control and health economy. The objective of this study conducted at the Teaching Hospital Peradeniya involving 371 chronic hypertensive patients followed up in hypertension clinic and medical wards was to provide an audit to current pattern of practice of prescribing of drugs to hypertensive patients. Data was collected using an interviewer administered questionnaire with the help of patients' clinical records.

Details about initially started drugs were available only with 247 patients and among them 55.87% had been started on Angiotensin Converting Enzyme Inhibitors (ACEI) or Angiotesin Receptor Blockers (ARBs) while Diuretics were used in 20.24% and Calcium Channel Blockers in 12.95%. 8% and 2.8% were stared on Beta Blockers and Alpha Blockers respectively. 87% of 371 patients were currently on ACEI or ARBs, 41% were on Diuretics, 30.77% were on Calcium Channel Blockers and 7.54% on Alpha Blockers. 45.28% were currently on duel therapy, 28.03% and 19.13% were on single drug and 3 drugs respectively while 2.96% were on 4 drugs. 4.5% were not on any drugs. 71.15% had controlled systolic blood pressure i.e. <140 mmHg while 86.79% had controlled diastolic blood pressure i.e. <90 mmHg at the time of interview.

In conclusion ACEI and ARBs are the most widely used antihypertensives and most of the patients have controlled blood pressure with the use of multiple drugs.

Knowledge, awareness, attitude and practice with regards to hypertension in a cohort of hypertensive patients

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It is crucial for hypertensive patients to have an adequate knowledge and awareness about hypertension, its complications and its control in order to build up better attitudes and practice to achieve treatment goals and prevent complications of hypertension. The aim of this study was to assess the knowledge, awareness and attitude regarding hypertension and the practice of treatment and follow up among a cohort of hypertensive patients. The study was conducted at the Teaching Hospital Peradeniya, Sri Lanka involving 357 hypertensive patients who were followed up in hypertension clinics or medical wards using an interviewer administered questionnaire.

The results indicated that 62.75% had a history of hypertension over five years and the majority (53.78%) was diagnosed to have hypertension in routine medical control while 19.33% were at emergency services and 7.84% were at screening programmes. 52.1% were diagnosed at and 60.22% were followed up at a tertiary care hospital. 52.1% undergoes blood pressure checkups once in 3 months while 45.94%, once a month. 59.1% were aware that they have a positive family history of hypertension. 96.64% were aware that they were on antihypertensives and 76.47% revealed that they take their medications regularly. Among the 23.53% who do not take medications regularly, 55.95% disclosed that they forget to take them, 13% didn't like the side effects and 8.33% take them only when they get symptoms. 79.27% were aware of the major complications of hypertension and 71.71% revealed that they were advised to change their life style in order to control their blood cholesterol level and blood pressure by a health care professional.

In conclusion we suggest that screening programmes should be upgraded to detect more cases and health care professionals should stress the importance of taking medications regularly and regular follow up in order to improve patient compliance.

Prevalence of modifiable and non-modifiable cardiovascular risk factors in a cohort of chronic hypertensive patients

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Hypertension is a highly prevalent chronic medical condition that leads to major end organ damage including ischaemic heart disease, Heart failure, Strokes, Chronic Kidney Disease and Peripheral Vascular Disease. The presence of additional cardiovascular risk factors in hypertensive patients accelerates the risk of those major complications. The aim of this study was to assess the prevalence of co-existing cardiovascular risk factor among 371 chronic hypertensive patients who were followed up in the medical wards and hypertension clinics of Teaching Hospital Peradeniya, Sri Lanka. Data was collected using an interviewer administered questionnaire which included data regarding the presence of modifiable and non-modifiable risk factors followed up by a brief physical examination including height, weight.

Among 371 patients, 118(31.8%) were males and 253(68.2%) were females and mean age for males was 65.51 years while for females it was 64.14. Among males, 77.1% were alcohol consumers and 76.27% were smokers. Those risk factors among females were negligible. Diabetes Mellitus was found in 34.1% of the total population with no significant difference in gender (p-value=0.610). From total population 39.5% were overweight and 25.3% were obese. Mean Body mass index (BMI) was 24.92 kg/m^2 (male-24.58, female-25.08, p-value=0.5453). 36.92% had at least one parent with hypertension while 39.1% had at least one sibling with hypertension. 66.8% had adequate level of physical activity i.e. >150min/week of moderate activity with no significant difference in gender (p-value=0.5418).

In conclusion we have identified that smoking and alcohol consumption were highly prevalent among males while diabetes mellitus and high BMI were frequently seen in hypertensive patients. Therefore it is crucial to improve patient education, early detection and control of those risk factors in order to control those modifiable risk factors.

Stimulated single fiber electromyography in orbicularis oculi muscle in carbamate insecticide poisoned patients: a preliminary study

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Intentional poisoning using carbamate pesticides are commonly seen in countries like Sri Lanka with high morbidity according to the World Health Organization. This study was conducted to assess the neuromuscular junctional impairment seen in carbamate patients using single fiber electromyography (sfEMG) in the view of developing it as a marker to predict the morbidity. Carbamate acts as a reversible inhibitor of acetylcholine esterase enzyme present in the neuromuscular junction. This is the first such series of carbamate patients (17) that had been investigated.

The study was conducted in the Toxicology Unit and the Neurophysiology Unit of the Faculty of Medicine, Peradeniya. sfEMG was conducted within 24 hours and every other day on carbamate ingested inward patients. The patients who were admitted with > 2 cholinergic features were recruited. Patients with 3/4 clinical criteria:neck muscle weakness, proximal muscle weakness, opthalmoplegia and respiratory failure were clinically diagnosed as intermediate syndrome (IMS), sequelae of the poisoning seen between 24-96 hours. In these patients zygomatic branch of the facial nerve was stimulated and sfEMG was recorded from orbicularis oculi muscle using a concentric needle electrode.

The number of carbamate ingested patients examined was 17(males: 15, age: 23-65 years). Mean duration of the stay in hospital was 115 hours (range: 24-216 hours). The number of patients who were clinically diagnosed with IMS was 10, out of which 7 had increased jitter between 24-96 hours. The odds ratio of having IMS in patients with increased jitter and with normal jitter was 5.83 (95% confidence interval: 0.49 – 86.29, Fisher's exact test $P = 0.15$).

Normal jitter for orbicularis occuli muscle is 39.8-43.7µs.Higher values were observed within 24-96 hours in 7/10 patients who were diagnosed as IMS. The likelihood of having an increased jitter value in those with IMS is 5.83 times greater than in others who were not diagnosed with IMS. The correlation was clinically significant indicating the need to study a larger sample.

As higher jitter values are seen in IMS patients, it is necessary to study a larger sample that had ingested carbamate, in order to develop sfEMG as a marker to predict the occurrence of IMS.

Abstract No: 367   *Health Sciences*

Effective induction of cytotoxic T Lymphocytes by PMDC derived exosomes for development of adaptive cellular immunotherapy/cell-free vaccine

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Cancer immunotherapy aims at improving survival and quality of life of cancer patients. Since few years, many studies have focused on dendritic cell derived-exosomes (DC-Exo) which can be used as a novel source of vaccinations. Recently a great deal of interest has been raised in PMDC cell lines which have been established at the University of Niigata (Japan).PMDC05 was generated by using leukemia blast cells and PMDC11 was derived from PMDC05 by transduction of the CD80 gene. This study aims to evaluate the effectiveness of DC-Exo to induce cytotoxic T lymphocyte (CTL) responses and antitumor immunity. Exosomes were isolated from PMDC by using the ExoQuick-TC solution. These exosomes were pulsed with CMVpp65 peptide to induce CTLs. The toxicity of CTL which is induced by DC-Exo was determined by the cytotoxicity assay. The statistical relevance of the difference in CMVpp65 specific CTL generation by DC-Exo was evaluated by one-way ANOVA test.

Transduction of the CD80 gene into PMDC05 increased the expression of CD80 in PMDC11. In addition, expression of CD4, CD54, CD56, CD123 and HLA-DRco-stimulatory molecules were increased. However, the expression of CD80 was decreased in PMDC05. PMDC11- derived exosomes (DC11-Exo) showed an expression of CD63 and CD80, while the expression of CD80 was negative in PMDC05-derived exosomes. (DC05-Exo)CD80 is important for antigen-presentation and stimulation of CTL. DC05-Exo which was pulsed with CMVpp65 induced a moderate number (0.43%) of CTL. Interestingly, DC11-Exo showed the ability to induce a higher number of CTL (1.83%).This might be due to the uptake of exogenous antigen by DC-Exo,in turn stimulating antigen-specific CTL via the MHC complexes and co-stimulatory molecules on DC-Exo.

This study provides evidence that exosomes which were released from PMDC would be in a position to develop anti-tumor immune responses. Furthermore, the efficiency in expression of immune responses by DC-Exo might be due to antigen cross-presentation. Since DC11-Exo has the ability to generate antigen specific CTL, DC-Exo could be used for the development of a cell-free vaccine in the future.

In vitro anti *Candida* effect of Sri Lankan virgin coconut oil

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Coconut oil obtained from *Cocus nucifera* is commonly used in Sri Lankan food. It is also a skin and hair remedy in native medicine. *Candida* is a commensal fungus found in human mucosa and skin. Whereas, Sri Lanka is a leading coconut producer in the world Sri Lankan virgin coconut oil (VCO) has not been explored for anti-*Candida* effect. This study aimed to investigate anti *Candida* effect of Sri Lankan VCO.

VCO extracted by fermentation method was used for the study. Mature coconut kernel was scraped and allowed for fermentation under sterile conditions. Resultant oil was separated by heating at a controlled temperature. Thus extracted VCO was divided into two samples. One sample was used directly to check the anti-*Candida* effect while other sample was subjected to partial hydrolysis. Hydrolysis was done by reflux condensing on sand bath using methanolic sodium hydroxide. Hydrolyzed oil was neutralized and extracted in hexane. Anti-*Candida* effect for both unhydrolyzed and hydrolyzed samples were tested against five species of *Candida*; *Candida albicans* (ATCC90028), *Candida glabrata* (ATCC90030), *Candida krusei* (ATCC6258), *Candida parapsilosis* (ATCC22019), *Candida tropicalis* (ATCC13803). Several diffusion techniques on Sabouraud's agar including disk diffusion, well diffusion and direct drop method were used to demonstrate anti *Candida* effect.

Unhydrolyzed VCO did not produce any significant inhibition zones against any of the *Candida* species tested. In contrast, hydrolyzed VCO produced significant inhibition zones against all *Candida* species tested. *C. glabrata* showed the highest mean inhibition zone (40.88mm) followed by *C. Tropicalis* (36.00mm), *C. Parapsilosis* (32.11mm) *C.albicans* (28.22mm) and *C. krusei* (23.88mm).

This study demonstrates that partially hydrolyzed Sri Lankan VCO obtained from fermentation method have anti-*Candida* effects which could be used as an alternative to resistant *Candida* in the future. Use of hydrolyzed Sri Lankan VCO in skin remedies may help control *Candida* colonization.

Maxillary and mandibular arch dimensions of a Sri Lankan population -a preliminary study

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The data available in the literature on maxillary and mandibular arch dimensions for Sri Lankan population are scanty. The present study was undertaken with the aim of determining the mandibular and maxillary arch dimensions and the variations in arch dimensions according to gender in Sri Lankans.

Dental casts of mandibular and maxillary arches of 193 adults (73 males and 120 females) aged between 20 to 25 years were prepared with hard plaster The study sample belonged to the Sinhalese ethnic group and selected randomly from a University community. The selected subjects had no history of orthodontic treatment and had the full complement of teeth with the normal occlusion. The length and width of the maxillary and mandibular arches were measured on photographs of the dental casts transferred to a computer using ImageJ software. Means and standard deviations were calculated for each measurement and differences in arch dimensions between males and females was analyzed using SPSS statistical software.

Upper and lower dental arches were wider and longer in males than females. The width of the upper dental arch was significantly higher at most levels in males than in females. Meanwhile except at level 1 (U2-U2), the length of the upper arch was not significantly different between males and females at every level observed. Furthermore, with respect to the lower arch, the width was statistically different at the level of premolars between males and females. Interestingly, the length was significantly higher in males compared to females at all levels observed except at level 6 (U7D-U7D)

The differences in arch dimensions between males and females are important in the management and treatment in orthodontics, forensic odontology and anthropology. However there is a need for studies using large and age diverse populations.

Relationship between dental amalgam and oral lichenoid reactions/ lichen planus

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Lichenoid reactions occur in susceptible individuals as a result of local toxic or allergic reactions due to the absorption of released mercury by oral soft tissues. In most patients, resolution of the lesions is noticed after replacement of amalgam restorations with other restorative materials. However the aetiology of lichenoid reactions remains unclear. The aim of this study was to understand the aetiology of lichenoid reactions, its correlation with amalgam restoration and its distribution with age and gender.

The study was conducted on 32 patients referred from the Department of Oral Medicine and Periodontology with a lichenoid reaction adjacent to an amalgam restoration (Group I) and speculatively screening 115 patients who presented to the Department of Restorative Dentistry with amalgam restorations (Group II). Out of the 115 participants in group II, 71 were female and 44 were male. Of these patients 13 female patients (18.3%) and 8 male patients (18.2%) had lichenoid lesions in relation to amalgam restorations. Age distribution of the participants ranged from 15 to 71. A majority of the participants were of the 25-34 age category. Lichenoid reaction was most prevalent (33.3%) in 45-54 age category. Of the patients in Group II, 81.7% did not have any lesions although amalgam restorations were present. The remaining 18.3% had evidence of a lichenoid reaction/lichen planus in the proximity of an amalgam restoration. Of the 32 patients in Group I, the amalgam restorations were replaced with light-cured composites and reviewed in 2 weeks, 1 month, 3 months and 6 months intervals to detect the response. 14 Patients in group I had complete resolution of the lesions with a further 10 showing evidence of reduction of the lesions within the 6-months review period.

The occurrence of lichenoid reactions was seen to increase with the advancing age with a peak at the middle age. Since most patients were relieved of their previous symptoms after replacement of amalgam, amalgam-restorations may act as causative factor for lichenoid lesions and replacement of such restorations could be advocated.

Incidence of pulp exposure after removal of deep carious lesions in permanent posterior teeth of adults: a randomized clinical trial comparing stepwise excavation vs. indirect pulp capping vs. complete excavation

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Avoiding pulp exposure in deep carious lesions that involve the inner third of dentine is beneficial, because it avoids costly and invasive endodontic treatments and allows teeth to be retained. The main strategies of caries removal range from, removing all affected (firm dentine, lathery dentine) and infected (soft dentine) dentine to leave only hard dentine to, not removing any carious dentine from the cavity. 1) Complete excavation (CE) aims to eliminate all affected and infected dentine to leave only sound dentine both on the peripheral walls and pulpal floor, 2) Indirect pulp capping (IPC) leaves firm dentine on the pulpal walls but retains some softened dentine on the cavity floor. 3) Stepwise excavation (SWE) is performed in two steps; the first step removes some soft dentine but excavates until hard dentine in the periphery and then restoring the cavity with a temporary filling material; after 3 to 12 months the tooth is restored permanently.

All new patients attending the diagnostic clinic, Faculty of Dental Sciences with restorable deep carious lesions in premolar and molar teeth were screened by one clinician and volunteers were selected on the basis of set inclusion and exclusion criteria. This randomized clinical trial was conducted using a computer-generated randomization list with three groups of single blind (patient) teeth from volunteers, to compare the effect of complete excavation vs indirect pulp capping vs stepwise excavation. The sample size was calculated using results of previous studies.

Odds ratio estimates revealed that indirect pulp capping and complete excavation had a greater probability of pulp exposure compared to the step wise excavation. Complete excavation had a greater chance of exposure compared to the step wise excavation.

It can be concluded that step wise excavation was the safest method of caries removal for deep lesions as it resulted in fewer pulp exposures.

Abstract No: 381 (Poster)   *Health Sciences*

Social and Health impact of flying Hymenoptera stings: experience in a region of central hill country of Sri Lanka

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Envenomation by flying hymenoptera species especially Asian Giant Bee (*Bambara*) and Hornet (*Debara*) sting are common environmental hazard in Sri Lanka. This is a descriptive retrospective study and data were collected from bed head tickets of the patients. Eighty patients presented following attacks by the above insects during year 2011/2012 to District Base Hospitals of Rikillagaskada and Teldeniya which are situated in two banks of Victoria reservoir were studied. The number of insects involved in an attack ranged from single to as high as 100 with a mean of 15 insects per victim. Majority had local reactions with an uncomplicated recovery except one, known to be allergic to Bee venom, developed Acute Coronary Syndrome (Kouni's Syndrome).

Cases presented with Asian Giant Bee and Hornet attacks were 54 (68 %) and 26 (32 %) respectively. Sixty three incidents (78.75%) were reported during windy seasons; May/ June 32 (40%) and August/ September 31 (38.75%). Six (7%) incidents were following provocation of Giant Asian honey Bees by eagles attacking their combs. All the patients had been exposed to attacks while in outdoor activities and male: female ratio was 1:1. The age of the victims was between 5 to 89 years (mean- 45.39 years). None of them had taken protective measures. The time lag between the incident and hospitalization was from 5 minutes to 7 hours (mean- 1.95 hours). Head and neck region was the primary target in 72 (90 %) victims and 55 (69%) incidents happened during morning hours. No deaths were reported during the study period.

The most common reactions to these stings are transient pain and redness at the site lasting a few hours (Local reaction). Most serious complication reported in this study was Kouni's syndrome. Risk factors for stings included day-time outdoor activities and period of year. Education of the public and facilitation of medical staff working in prevalent regions is a current need.

Assessment of mothers' knowledge about factors related to feeding their infants with cleft lip/palate

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Cleft of the lip and / or palate are common birth defects of complex aetiology. Children born with these deformities have a range of functional problems in feeding which leads to failure in weight gain. Additionally, mother's awareness and advice given by health care providers play a major role in overcoming feeding difficulties in children with clefts. This study was aimed at assessing the mothers' knowledge about factors related to feeding their children with clefts attending the Oral and Maxillofacial Surgery Clinic, Dental Hospital, Peradeniya.

This cross-sectional observation study was carried out among a random sample of fifty four eligible mothers whose infants had cleft lip/palate attending the Oral and Maxillofacial Surgery Clinic, Dental Hospital, Peradeniya from September 2015 to January 2016. An interviewer administered pre-tested and validated questionnaire was used to collect data. Questions were mainly aimed at assessing knowledge on general and specific feeding practices. Questions were further grouped into breast feeding, weaning, complementary feeding and growth and development of the child.

Nearly fifty percent of mothers of cleft children had received advice regarding feeding either from a doctor, nurse, midwife or a cleft centre. Most of them (64.8%) received instructions from a cleft centre. Over two thirds of the mothers were aware of the general health (sleeping duration, gradual growth increase, inter-current infection and growth failure) of the infant and general feeding guidelines on breast feeding, weaning and the importance of a balanced diet. On the contrary, 57.4% and 55.6% of mothers were not aware that burping the infant with oral cleft must be done during and after feeding and other than water and thin fluid no junk food should be given in between meals respectively.

In conclusion, creating awareness in mothers of infants with clefts on special factors such as burping and complementary feeding needs improvement with simultaneous monitoring of weight gain. It is important that all health caregivers are well aware of the feeding instructions that have to be given to mothers with cleft babies.

Descriptive analysis and clinical outcomes of patients presented with lower impacted third molars to the District General Hospital Nuwara Eliya

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Mandibular third molars (MTM) are the commonest teeth to be impacted. Therefore, removal of MTM is a frequent procedure carried out in oral surgery practice. Hence, the purpose of this study was to evaluate the patterns of MTM impaction, causes for removal and complications following surgery in patients attending the Oral and Maxillo-Facial unit (OMF) of the District General Hospital (DGH) Nuwara Eliya.

In this study, 164 patients who presented with complaints about MTM to the OMF unit, DGH, Nuwara Eliya from May 2015 to June 2016 were evaluated. Age, gender, ethnicity, main complaint, clinical findings, angulation patterns, compliance and postoperative complications were analysed. Radiographs were taken for all patients for management purposes.

There were 48.8% (n=80) Sinhalese, 44.5% Tamils and 6.7% Muslims, out of which 64.6% (n=106) were females. Their ages ranged from 18 to 58 years with a mean of 31.7 years and the majority (49.4%) belonged to the age group of 21-30 years. The frequent complaints were pain (74.4%), decayed teeth (23.2%) and fractured MTM during previous extraction attempts (2.4%). The prevalence of impacted mandibular third molar teeth was almost similar on both left (50.7%) and right (49.3%) sides. Interestingly, it was observed that, disto-angular impaction (30.3%) was the commonest type of impaction. Two third of patients (76.2%) attended the clinic on the given date of appointment and underwent removal of the causative MTM. The commonest clinical finding was caries in erupted MTM (71.2%) followed by pericoronitis (13.6%) and caries in partially erupted teeth (12.8%). The majority of MTM (64.8%) were removed surgically and the remaining 35.2% of the erupted MTM by normal forcep extraction. Only two patients reported complications at one week review; symptoms associated with nerve injury and temporo-mandibular joint pain.

In conclusion, this study describes the characteristics of MTM removal in a mixed, rural population of Sri Lanka. Nerve related complications after MTM removal were low.

Patterns of mandibular third molar impaction and its relationship to the inferior alveolar canal: retrospective Cone Beam Computed Tomography analysis in a group of Sri Lankan patients

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Impacted mandibular third molar (IMTM) tooth is one of the most commonly impacted teeth in the dental arch with a frequency of occurrence between 18-32 %. Cone beam computed tomography (CBCT) provides a precise three dimensional analysis of vicinity of IMTM which helps in surgical decision making.

Objective of this study was to analyze the pattern of IMTM and the relationship of inferior alveolar canal to the tooth in 68 patients presented in year 2014 to Division of Oral Medicine and Radiology for preoperative CBCT assessment.

The study sample included retrospective analysis of 112 IMTM teeth in 68 patients. Sample consisted 54.4 % females and 45.4 % males with average age of 28 years.

Pattern of impaction was determined according to Pell and Gregory classification of IMTM and categorization of angulation of IMTM was done in accordance with modified Winter's classification. Preoperative radiological assessment of IMTM was carried out with the aim of establishing relationship of inferior alveolar canal to the roots of IMTM, analyzing their morphology, predicting anticipated difficulty in exodontia of IMTM and complications such as damaging the inferior alveolar nerve. All the CBCT scans were re-assessed and measurements were done using the tools provided in the CBCT software.

Pell and Gregory Class I B pattern of impaction was predominant in the sample with mesioangular impaction being the most commonly occurring angulation of impaction. The inferior alveolar canal was placed on buccal aspect of the root apex in 35.7% cases whereas in 33.9% it was lingually placed. Average depth of impaction was recorded to be 10.23mm and average mesio-distal and bucco-lingual lengths were found to be 11.15mm and 10.18 mm respectively. Two roots were present in 92% of the teeth studied. Pattern of impaction and the morphology of IMTM in current study comply with international norms except in few aspects.

Potential use of mechanical methods for sex separation of dengue vector mosquitoes for large scale laboratory rearing

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Dengue fever is a rapidly emerging arthropod-borne viral disease that has threatened approximately one-third of the world's population. Due to the absence of an effective drug or vaccine for dengue, prime focus of health sectors lies on the biological control of vector densities via innovative approaches such as Sterile Insect Techniques and Incompatible Insect Techniques etc. This requires mass rearing and releasing of vectors in to the environment. As female mosquitoes are capable of transmitting the disease, elimination of females from mass releasing remains is critical. Furthermore, such eliminations promote the mating of released males with wild females, increasing the efficiency of the techniques. Among numerous mosquito sex separation methods, mechanical sex separation methods are often practiced due to their high effectiveness. The current study investigated the efficiency of a mechanical sex separation method namely; Fay and Morlan glass plate separation. Batches of 500 *Ae. aegypti* larvae were reared under normal and enhanced colony conditions. The emerged pupae from each colony were screened by devising the Fay and Morlan glass plate separator. The separated sets of pupae from each colony were placed in separate cages and reared up to adults for morphological identification. 98.69% (n=227) of the males were separated in the first band along with 15.93% (n=43) of females. The second band included the rest of the males (1.30%, n=3) and females (84.07%, n=227). Meanwhile out of 500 *Ae. aegypti* pupae reared under enhanced rearing conditions, 100% (n=240) of the males were separated as the first band along with 1.15% (n=3) of females. Second band included the rest 98.85% (n=257) of the females. According to the Paired Chi-Square statistics, the percentage of males and females separated at each band differed significantly ($p < 0.05$) at 95% level of confidence. In this method, these separations resulted in a mortality of 4% and 5%, respectively. In conclusion, Fay & Morlan glass plate separator was able to yield a 100% separation of males with only 1.15% females under enhanced culture conditions, exhibiting its potential to be used as a separation method of *Ae. Aegypti* mosquitoes with colony enhancements.

Identification of mutations in *BRCA1* exon 11 of breast cancer confirmed patients and in at risk individuals

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Breast cancer is the commonest malignancy among females. Of the risk factors leading to develop breast cancer, germline mutations and sequence variance of breast cancer susceptibility genes play a major role.This study was conducted to identify germline mutations in exon 11 of *BRCA1* breast cancer susceptibility gene.Exon 11of *BRCA1*is a common region of mutations in breast cancer patients and also in individuals with a family history of breast cancer. The study consists of a total of 43 breast cancer patients with family history (N=12) and without a family history (N=31). About 26 currently unaffected individuals with first or second degree relatives having breast cancer and 25 controls (those who are without any personnel or family history of any cancer) were also included. Self-administered questionnaires were given to the participants to evaluate the personal and family histories of breast and other cancers. Blood samples were collected for detection of mutations in exon 11 of *BRCA1* gene. Following genomic DNA extraction, mutation detection was performed using polymerase chain reaction by amplifying exon 11which consist of 3426 base pairs that represents 60% of the coding sequence. Upon amplification, PCR products which showed abnormal migration patterns in gel electrophoresis were sequenced.

Mean age of the onset for 43 women diagnosed with breast cancer in this study was 52.256±9.70 years. Mean age at diagnosis of breast cancer patients with family history was 55.08 ± 6.788 and without family history was 51.16 ±10.51. Furthermore, abnormal migration patterns in PCR products were observed in breast cancer confirmed patients and in at risk individuals upon gel electrophoresis. PCR products which show the size variations were subjected for direct sequencing. Seventeen sequence variations were found in the exon 11 of three sequenced samples. G3135delC/exon 11 was observed. Previously reported six polymorphisms were also identified in these sequences. Results obtained from this study confirmed the presence of single nucleotide polymorphisms in the exon 11 of *BRCA1* gene of the individuals included in this study.

Patient radiation dose evaluation in dual energy x-ray absorptiometry at a selected private hospital

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Dual Energy X-Ray radiation with specialized digital detection system used in Dual Energy X-Ray Absorptiormetry (DEXA) scanning is a highly specialized radiological procedure used to detect pathological and structural changes of the skeletal system in patients with advanced age. DEXA scan is, by far the most widely used technique for bone mineral measurements, since it is considered to be cheap, accessible, easy to use and able to provide an accurate estimation of bone mineral density in adults. It is crucial to define and optimize the radiation dose received by patients during DEXA examination, taking into account that females have a higher risk for stochastic effects than their counterparts due to higher radio sensitivity of uterus and ovaries. According to the International Commission on Radiological Protection, the effective dose is the most appropriate quantity, correlating to the risk from exposures during radiological procedures.

The objective of this study was to indirectly estimate the effective dose and entrance surface dose (ESD) to female and male patients subjected to DEXA scanning at the Lanka Hospitals by using dose area product meter (DAP) value. Results were compared with available international reference levels to identify factors associated with higher effective doses where necessary.

DAP values recorded for 60 patients included both hips and spine AP. The mean DAP values for both hips and spine were 1.6 and 2.4 Gycm^2 respectively. The calculated mean ESD for left hip, right hip and spine AP were 133.66, 133.80 and 147.79 µGy respectively. The calculated mean effective doses for the same regions were 2.16, 2.16 and 2.88 mSv. The ESD and effective doses for both hips and spine were significantly lower than the international reference levels.

In this study the lower radiation dose was found to contribute a substantial portion to the patients and depends on many interrelated parameters which include the equipment, bone mineral density, difference due to Caucasian race, scan mode and variables in the clinical situation.

Estimation of radiation dose received by a nurse working in a Nuclear Medicine unit at a selected private hospital, Sri Lanka

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Physicians, nuclear medicine technologists, nurses who work in nuclear medicine units are exposed to ionizing radiation. This study was carried out to measure the radiation dose to the body of a nurse who was administrating ^{99m}Tc-labeled radiopharmaceuticals at a Nuclear Medicine Department of a selected private hospital. The radiation dose was measured by using an electronic pocket dosimeter (EPD) during a three month period and the annual equivalent dose to the body was estimated. The aim of the study was to determine if the equivalent dose is within the recommended dose limits of the ICRP.

In addition to her routinely used thermoluminescent dosimeter (TLD), an electronic pocket dosimeter that has the ability of measuring the real time radiation dose was worn on the chest area by the nurse and the radiation doses were recorded on a daily basis. The recorded radiation dose varied according to factors such as the number of procedures, type of procedure and the age of the patient and cooperation of the patient. 449 of ^{99m}Tc procedures were performed during the study period.

The radiation doses recorded for three months were used to estimate the annual radiation dose. Using the typical yearly workload the annual radiation dose was calculated and it ranged from 1.01 mSv to 1.52 mSv. According to the routinely used TLD readings, the mean annual radiation dose was calculated as 1.25 mSv and is almost similar to the estimated dose in the study. These results were well below the value of 20 mSv/year of the ICRP recommended dose limit.

Although doses received in the study were well below the dose needed to result deterministic effects, there is a risk of occurrence of stochastic effects. Therefore it is necessary to encourage the staff to minimize radiation dose by using appropriate protective measures whenever necessary.

Comparison of e-cadherin expression in node positive and node negative invasive breast carcinomas

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Breast cancer is the commonest malignancy and the leading cause of cancer related deaths among females, mainly due to metastasis. Markers which can predict metastasis are valuable in determing prognosis and therapeutic regimes. E-cadherin is expressed in most epithelial cells. Down-regulation of E-cadherin is reported to reflect the progression and metastasis in breast cancer. This study was carried out to determine the expression of the epithelial marker 'E-cadherin' in node-positive and node-negative, primary invasive breast carcinoma- No special type (NST) and determine its predictive value of metastasis by comparing the expression levels between the two groups.

Formalin-fixed, paraffin-embedded tissue sections of 36 primary invasive breast carcinoma (NST) comprising 19 node-positive and 17 node-negative carcinomas were included. Immunohistochemical staining was done on each tumour sample and normal breast tissue of the same patient with anti-E-cadherin primary antibody. Cell membranes of epithelial cells positive for E-cadherin were stained brown. Stained sections were viewed under light microscopy (40 x10) and 08 random fields of 100 cells were assessed and positive cells were expressed as percentages.

The mean age of the group was 62 ± 13.04 years (28–86 years) while the mean ages of node negative and node positive groups were 59 years and 48 years respectively. Normal ductal cell membranes showed E-cadherin expression in 98.5% of cells. Average E-cadherin expression in node-negative group was 84.72% (63.33%-96.67%) whereas it was reduced to 69.87% (27.67%-97.33%) in the node-positive group and the difference was statistically significant ($p=0.018$). E-cadherin expression between normal ductal cells and the node-positive group was statistically significant ($p=0.04$) whereas the difference was not significant between the normal ductal cells and the node-negative group ($p>0.05$).

These observations are suggestive of down regulation of 'E-cadherin' expression in tumours with nodal metastasis. Metastasis being the leading cause of death due to breast cancer, identifying patients with high risk of developing metastasis is of prognostic and therapeutic value. This study demonstrates the possibility of using 'down regulation of E-cadherin expression as an indicator to predict the metastatic risk of primary breast cancer. Further studies are being carried out to evaluate its expression pattern.

Expression of ɤ-h2ax and p53 in oral cancer and oral potentially malignant diseases with areca nut history

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DNA double strand breaks (DSBs) marker ɤ-H2AX and tumor suppressor p53 are direct substances and central players in cellular DNA damage responses (DDR). Emerging evidence suggests that an intact DDR serves as a potent barrier for malignant transformation. The aim of this study was to analyze ɤ-H2AX and p53 expressions in oral cancer and oral potentially malignant diseases (OPMDs) with Areca Nut (AN) history.

Immunohistochemically, we investigated DDR by analyzing expressions of ɤ-H2AX and p53 in OPMDs. We utilized 15 each archival biopsy samples of oral leukoplakia (OL), oral submucous fibrosis (OSMF) and oral squamous cell carcinoma (OSCC) with the history of AN consumption. We also observed AN induced DNA DSBs in cancer cell lines using fluorescence activated cell sorting (FACS) analysis. Statistical evaluation was done by Fisher exact test and p value <0.05 considered as significant.

ɤ-H2AX accumulated in OL ($p = 0.002$), OSMF ($p = 0.000$) and OSCC ($p = 0.000$) significantly compared to the normal oral mucosa (NOM). Among OPMDs, H2AX phosphorylation is significantly low in OL, but its level peaked in OSCCs ($p = 0.032$). Also p53 was significantly expressed in OL ($p = 0.000$), OSMF ($p = 0.000$) and OSCC ($p = 0.000$) compared to NOM. In contrast to the findings of ɤ-H2AX, both OL ($p = 0.013$) and OSMF ($P=0.028$) denoted lower expressions of p53 compared to OSCC. We also noted that there was a positive correlation between two biomarkers in our samples ($p = 0.000$). In-vitro studies showed ɤ-H2AX accumulation in YD38 ($P = 0.12$) and HSC2 ($p=0.028$) cancer cells increased following AN treatment.

Our results suggest that the expression of ɤ-H2AX and p53 is predominant in OSCCs compared to non-transformed oral mucosal tissues and in-vitro data provides strong evidence that AN is responsible for that evoked response. Furthermore, DNA damage occurs in early stages of oral pre-cancer and increased during the course of oral carcinogenesis. Thus, our findings suggest that combined expressions of ɤ-H2AX and p53 can be used as a tool for early detection of oral cancer in patients with the history of AN consumption.

Salacia reticulata (kothala himbutu) and *Psychotria sarmentosa* (gonika) extracts ameliorates ovariectomy induced bone destruction

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Osteoporosis is considered as a "silent killer" because it occurs swiftly and depletes as much as 40% peak bone mass before being detected. Kothala Himbutu (*Salacia reticulata*) (KH) and Gonika (*Psychotria sarmentosa*) (G) are two herbal plants used by ayurvedic practitioners to treat bone related problems. The current study endeavors to measure the effects of herbal extracts on bone destruction. Measurements of bone destruction were carried out by measuring a specific bone desctruction marker i.e. cross-linked C-telopeptide of type l collagen (CTX-1) in serum.

To this end an established ovariectomy-(OVX)-induced bone destruction mouse model was used. Thirty-six 12-week-old female BALB/c mice were weighed and randomly divided into six groups (n=6). Five groups were subjected to the OVX-operation and the other group was subjected to a sham operation (negative control). One group (OVX/Vehicle) of OVX mice was used as a positive control. OVX/Vehicle and the sham group were fed daily with distilled water. Two groups (KH/ low dose (LD; 25mg/kg), KH/ high dose (HD; 50mg/kg)) of OVX mice were fed with aqueous extract of KH leaves in two doses. The remaining two groups (G/LD, G/HD) of OVX mice were fed with aqueous extract of G leaves in two doses. Mice were given food and water *ad libitum* for four weeks and before sacrifice, blood was collected.

A significant increase of CTX-1 level in OVX/Vehicle (0.835ng/ml ± 0.028) in serum confirmed bone destruction (p< 0.005 vs sham). A significant decrease in serum CTX-1 was detected in the mice fed with high doses of KH (0.652ng/ml ± 0.035; p< 0.005 vs OVX/Vehicle) and G (0.672ng/ml ± 0.012; p< 0.05 vs OVX/Vehicle). Liver, kidney and pancreas were processed using standard tissue processing techniques and stained with haematoxylin and eosin. Sections were analysed, and no remarkable changes were noticed in the test groups. Finally, the results indicated that the herbal extracts ameliorate bone destruction in OVX mice. Further studies are necessary to clarify the mechanism of action of these herbal extracts.

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Two case reports on dengue haemorrhagic fever complicated with abdominal compartment syndrome and acute liver failure

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Dengue is one of the most common arboviral illnesses in humans. Here we present two cases of dengue haemorrhagic fever with unusual presentation. Dengue haemorrhagic fever with atypical manifestations such as myocarditis, encephalitis, hepatitis, Rey's Syndrome, TTP and HUS has been reported time to time during epidemics. Early identification of the above complications which can be difficult to diagnose at the initial stage is important in order to prevent fatal outcomes.

The main objective of this study was to further evaluate atypical complications of dengue haemorrhagic fever and to open up new management strategies for dengue fever. We selected two patients with dengue haemorrhagic fever where, one patient developed abdominal compartment syndrome and the other developed acute liver failure, both being atypical complications of dengue haemorrhagic fever which are difficult to manage.

The first case is about a 22 year old girl who developed dengue heamorrhagic fever with rapidly progressing ascites which lead to abdominal compartment, requiring aggressive fluid management. With the development of fluid leak there was a significant change in her serum albumin levels without much fluctuation in the liver enzymes and comparatively poor resolution of ascites and delayed recovery. The second case is about a 39 year female who presented with compensated shock and acute hepatitis which lead to acute liver failure. She also had a persistent reduction in serum albumin levels requiring treatment with human albumin. But, in contrast to the first patient, her liver enzymes showed a marked elevation. The first patient developed abdominal compartment syndrome during the critical phase whereas the second patient went into acute liver failure after completion of the critical phase.

Assessment of dietary diversity among community dwelling elderly in Kandy district: a pilot study

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Diverse diet reflects the overall nutritional quality and nutrient adequacy of the diet. Multiple nutrient deficiencies are more likely to occur with the aging process, especially in populations based on a monotonous cereal based diet. Available scientific evidence has identified Dietary Diversity Score (DDS) and Food Variety Score (FVS) as potentially useful indicators of macro and micronutrient diet adequacy. Hence, the objective of the study was to assess the dietary diversity among the elderly population in Kandy district, Sri Lanka using DDS, FVS and DSS.

This was a pilot study of a cross sectional design. A convenience sample of 60 elderly/ older people aged > 60 years, were randomly selected for the sample. A single 24 hour dietary recall was performed to assess the dietary intake and to compute three dietary scores: Dietary Diversity Score (DDS) and Food Variety Score (FVS) and Dietary Serving Score (DSS). Twelve major food groups were used to calculate DDS based on the local and international food grouping techniques adapting the cultural context. Six food groups were used to compute DSS using the scoring system.

The mean FVS of the study sample was 11.33 (SD 2.6), while the minimum and maximum values were 7 and 20 respectively. The average of the DDS was 7.4 (SD 1.1) within the range of 5-10. All the elders consumed some kind of a cereal and sources of oil/ fat, while 95% consumed sugar/ sweets. Only half of the population consumed green leafy vegetables while fruit consumption was less than 50%. Consumption of animal food was comparatively low; however, meat (10%) and eggs (5%) showed significantly low consumption compared to fish (65%). Mean DSS was 9.8 (SD 1.6). The higher and lower means of DSS was related to cereals/ roots and the fruit group respectively. There are no established cut off points for DDS, FVS and DSS to indicate adequacy of dietary diversity.

In conclusion, all the elders consumed cereals as their major energy source. However, consumption of certain food groups such as fruits and animal products were lower than the recommended servings. Hence, interventions must be taken to improve the diet of the elderly.

Presence of an abnormally positioned brachiocephalic artery and common carotid arteries in a female corpse: a case report

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The brachiocephalic artery (BCA) arises from the aortic arch behind the midpoint of the manubrium and ascends postero-laterally towards the neck in front of the trachea. It divides in to right subclavian and right common carotid artery (RCCA) behind the upper border of the right sternoclavicular joint. The left common carotid artery (LCCA) is arising as a direct branch of the arch of the aorta. Anomalies of BCA and common carotid arteries in their course and branching pattern occur frequently and are a potential surgical hazard in various operative procedures in the neck.

This case report describes an anomalous course and bifurcation of brachiocephalic and common carotid arteries in a female cadaver found during a routine dissection session at the Department of Anatomy, Faculty of Medicine, Peradeniya.

Here, the BCA had a normal origin and ascended upwards in front of the trachea up to the lower border of the 2nd tracheal cartilage, located beneath the left lobe and the isthmus of the thyroid crossing the trachea transversely towards the right side on the third tracheal cartilage to lie beneath the right lobe of the thyroid and bifurcates. The total length of the BCA was 3.8 cm that included the ascending part of1.3cmand a transverse part of 2.5cm.

RCCA had abnormal course and bifurcated at the level of the tip of the grater horn of the hyoid bone. The LCC had a normal intra-thoracic course and just above the level of the sternoclavicular joint, it kinked medially and posteriorly making an angle of 60 degrees. Then, it again ran anteriorly and ascended up to the left of the left thyroid lobe. LCCA too bifurcated at the same level as the RCCA.

High bifurcation of BCA is rare, and reported in cadaveric studies as an accidental finding in patients with problems related structures in the neck. Other than its vulnerability in surgical procedures and interventions in the neck region, suprasternal pulsations of BCA may mimic an aortic aneurysm. Further, it may cause problems in the diagnosis of other conditions such as thyroid pathologies. As such, identification of high bifurcation of the BCA is important in clinical practice.

Evaluating probiotic attributes of *Lactobacillus* sp isolated from plaque samples taken from male adults with dental caries

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Probiotics [Greek *pro*, for, and *bios*, life] are live microorganisms which can confer health benefits on the host. Lactic acid bacteria (*Lactobacillus, Leuconostoc, Pediococcus and Streptococcus*) and *bifidobacteria* are the most common type of probiotic microorganisms. Dental caries and plaque samples associated with dental caries can be considered as sources of *Lactobacilli*. This study was carried out to evaluate probiotic attributes of *Lactobacilli* which were isolated from plaque samples from dental caries. Thirty (30) plaque samples were obtained from male adults who had dental caries. A total of nineteen (19) isolates were identified as *Lactobacilli* based on morphological and biochemical tests. Those nineteen (19) isolates were evaluated for their probiotic attributes such as resistance to low pH, resistance to bile salt, antimicrobial activity against *Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Klebsiella pneumonia* and *Candida albicans,* antibiotic resistance activity against Norfloxacin, Nalidixic Acid, Augmentin and Ciprofloxacin, haemolytic activity and DNase activity. It was observed that none of the isolates were able to survive at low pH (pH=3). Only two isolates (PS 72 and PS 231) were able to survive at 0.3% bile salt. None of the isolates were able to exhibit antimicrobial activity and resistance to antibiotics. All isolates exhibited α-hemolysis. None of the isolates showed DNase activity.

After evaluating all nineteen (19) isolates for their probiotic attributes it was found that they have only one probiotic attribute (negative DNase activity) out of the tested six probiotic attributes. Therefore *Lactobacillus* sp. isolated from plaque samples taken from male adults with dental caries lack probiotic attributes.

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Bisphenol A (BPA) impairs oocyte development via suppression of nuclear and cytoplasmic maturation and reducing granulosa cells viability and functions

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Bisphenol A (BPA) a commonly used industrial chemical which is considered an endocrine disruptive chemical (EDC). Even though the effects of BPA as an EDC are well known, many questions related to its effects on reproduction still remain unanswered. Thus, the present study was conducted to analyse the effects of BPA on the mammalian ovary, using in vitro granulosa cell and oocyte culture models treated with selected doses of BPA. Isolated cumulus oocyte complexes (ovine origin) and primary granulosa cells (porcine origin) from local slaughter houses were exposed to different doses of BPA (0.3, 3.0, 30 μg/ml). After a 24 hour incubation period, cumulus cell expansion and nuclear maturation rates were determined in the oocytes. The porcine granulosa cells were also exposed to the same dosage and effect of BPA on viability and the prostaglandin synthesis cascade were analyzed. After 24 hrs treatment, the cumulus expansion was significantly reduced at 3 and 30 μg/ml BPA concentrations compared to the non-treated control ($p < 0.05$). The highest dose of BPA (30 μg/ml) showed the maximum effect. The cell density of the 24hrs treated primary granulosa cells was reduced along with the morphological changes such as a shrunken matrix and elongated cells. The effects of BPA increased in a dose-dependent manner and the viability was decreased significantly but, no significant differences were observed on cell doubling time. The mRNA expression of both PGES and PGFS were up regulated in 0.3 μg/ml BPA treated samples whereas the two genes were significantly down regulated in 30.0 μg/ml BPA treated samples. Interestingly, the expression of PGES mRNA was up regulated while the expression of PGFS mRNA was down regulated in 3.0 μg/ml BPA treated granulosa cells. Overall, our data suggests that the changes in the viability and gene expression of PGES and PGFS in granulosa cells may alter the ovarian function which could adversely affect the stability, growth and viability of cells which may ultimately have an effect on the cytoplasmic maturation of oocytes in mammals and the overall function of the ovaries as well.

Modelling primary auditory cortex hemodynamic response using fMRI data

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This project presents the modeling of the hemodynamic response of the primary auditory cortex using fMRI data. fMRI can be used to map the areas of the brain that are active during a task. The changes in the cerebral blood flow (CBF) and blood oxygenation level with neural activities in the brain are detectable by fMRI techniques. It is an indirect measure of neural activity. Different models are used to describe the relationship between the neuronal activity and the CBF, the cerebral blood volume (CBV) and other hemodynamic parameters. Mathematical models for this hemodynamic response are described as the blood oxygenation level dependent (BOLD) signal as a function of changes in the cerebral oxygen extraction fraction (E) and the CBV. The nonlinearities in the hemodynamic response due to neural activity will contribute to the nonlinearities in the BOLD signal. The techniques that are used to model the nonlinearities of the BOLD signal can be categorized as physiological models, data driven approaches and various parametric estimation techniques.

The most commonly used physiological model is the Balloon Model proposed by Buxton et al. in 1998. This is used as a basis to depict the dynamic change in deoxyhemoglobin during a neural activation coupling with the CBF and the oxygen metabolism. Here, the venous compartment is compared to a distensible balloon. The inflow to the balloon fin is the cerebral blood flow while the outflow from the balloon spout is an increasing function of the balloon volume. The balloon model is considered as the most accurate model up to date to model the hemodynamic response.

In this research, the primary auditory cortex of the brain is modeled in MATLAB© using the Balloon Model as the reference. A frequency sweep lasting 0.75s was used as the stimulus to obtain fMRI data from 20 subjects around the auditory cortex. Data for a specific stimulus paradigm is extracted and analyzed in order to obtain the distributions of optimal parameter values of the balloon model to fit the model to the signal obtained from the extracted data.

Health Sciences

Carrier status of pathogenic leptospires among swine slaughtered for human consumption in Sri Lanka

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Leptospirosis is a zoonotic disease caused by pathogenic species of Genes *Leptospira* that affects humans and a wide range of domestic and wild animals. In livestock industry, infected animals possess a zoonotic threat to the workers. The aim of this study was to identify the carrier status of pathogenic leptosprires among pigs slaughtered for human consumption in Sri Lanka.

Parts of kidneys from 105 pigs slaughtered for human consumption were initially collected from 4 provinces of Sri Lanka. Another 13 swine kidney portions including their blood (13) and urine (12) were collected from locations where Leptospirosis-positive results were detected from the initial screening. Extracted DNA were initially subjected to *flaB* nested-PCR to detect the presence of pathogenic leptospiral DNA. All positive kidney DNA samples were checked again using *secY* PCR. The *flaB* and *secY* PCR positive amplicons were sequenced, and phylogenetic tree was constructed. Serum samples of PCR positive pigs were subjected to Microscopic Agglutination Test (MAT) to determine the infective serogroup. DNA extracted from urine and serum of PCR positive pigs were subjected to Loop-mediated isothermal amplification (LAMP) to detect the presence of pathogenic leptospires DNA. All pigs were clinically normal at the ante-mortem examination.

Out of 105 kidney samples, 7 were *flaB* positive. All of the positive samples originated from a single farm. From the follow up collection, 11 out of 13 kidney samples were again *flaB* positive. All 18 samples were positive for *secY* PCR too. The phylogenetic analysis confirmed that the organism is *Leptospira interrogans*. MAT results of the sera showed that the serogroups of infected leptospires were Cannicola, Icterohaemorrhagiae and Autumnalis. LAMP results of sera and urine showed three positives and seven positives respectively.

The current study revealed that the pigs slaughtered for human consumption could be chronically infected with pathogenic leptospires. However, infection is not widely spread, and is localised to a single farm from which it can spread via transportation of animals and handling of raw meat. Therefore such contaminated farms can possess a great threat to both humans and other animals.

Analysis of maxillary sinus volume by Computed Tomography (CT) scan for age and gender detection in a sample of Sri Lankans

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It has been reported that maxillary sinus remains intact although the skull and other bones may be badly disfigured. Therefore the measurements of maxillary sinuses in computed tomography (CT) scans can be used for determination of age and gender when other methods are inconclusive. The aim of this study was to compare the volume of the maxillary sinus, between the left and right, and between males and females by CT scan for gender and age determination. 146 patients (84 males &62 females) were examined on *Toshiba (Alexion)* 16 slice Helical CT scanner. Volume images were collected from the CT database and analysed by medical graded Vitrea FX (Toshiba) vital image post processing work station. The longest distances measured on right and left maxillary sinuses were antero-posterior (AP) diameter on axial reconstructed image, transverse diameter/width on axial reconstructed image and cranio-caudal (CC) diameter/height on coronal reconstructed image. Maxillary sinus volume of each side was calculated using a proven mathematical formula of (AP diameter*height*width*0.52).The mean of each sinus volume was calculated for males and females. Data were analysed using the independent sample *t-test*.

The mean volume of the right male sinus was 12164 ($\pm$3347) mm³ with a range of 5591 - 16978 mm³ while it was 12459 ($\pm$3474) mm³ for the left side with a range of 5788 – 17954 mm³. The mean volume of the right female sinus was 11553 ($\pm$2776) mm³ and ranged from 7128 – 16471 mm³ while it was 11518 ($\pm$2378) mm³ for the left side with a range of 8142- 15619 mm³. The volume of the sinus increased with age in both genders. The volume of the maxillary sinus of males was found to be greater than those of females and this difference was statistically significant *(p<0.05)* for left sinus. We concluded that CT measurement of maxillary sinus volume may be useful in determining the age and gender in forensic anthropology to some extent and further the measurement of the left side maxillary sinus volume can be used to determine the gender.

Study of physico-chemical parameters of atorvastatin tablets in Sri Lankan market

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Atorvastatin calcium (ATV-Ca) is a synthetic lipid lowering drug which belongs to statin group. It is most commonly prescribed for the treatment of hyperlipidemia and cardiovascular diseases. ATV-Ca is an inhibitor of 3-hydroxy-3-methylglutaryl-Coenzyme A (HMG-CoA) reductase. There are five brands of ATV-Ca available in the Sri Lankan market. However there is a huge price variation among these brands. But each and every brand exactly consists of the same dosage, therapeutic effect, safety and strength as the original drug. This study assesses in-vitro quality control tests and impurity profile of five brands of ATV-Ca available in the Sri Lankan market. All tests viz: uniformity of weight, disintegration, hardness and friability were carried out according to the British Pharmacopoeia, Indian Pharmacopoeia and United State Pharmacopoeia. Each brand of ATV-Ca tablets (Atorva, Atocor, Aztor, Atorlip and SPC) were collected in authorized pharmacies in Kegalle, Peradeniya and Kandy. Assay test and analysis of impurity profile for each brand of ATV-Ca were carried out by HPLC method. The absorbance of the solution of the tablet was measured by UV-VIS spectrometer at 246 nm wavelength. According to the assay test, all brands except brand E are in acceptable range (90%-110%: IP 2010). Minor impurities were only in brand D and E with impurity profile analysis. There is no significant difference between friability, hardness and uniformity of weight of all brands. In the disintegration test, the highest disintegration time (7.27 min) was observed for sample B, and the minimum disintegration time (3.38 min) was reported for sample A tablets. All the samples passed the BP specifications for disintegration rate test, indicating that all the disintegration times were within the BP limit of 30 minutes. In acid test, brand A showed the highest degradation. Degradation of other brands in their descending order were; D=E>B>C. In base test, brand D showed the highest degradation and brand C showed the lowest degradation with pH 13. In thermal stability test, brand D showed the highest degradation and brand C showed the lowest degradation. According to the USP specified limitations, all brands except sample C were degraded when the UV radiation was introduced. The highest degraded brand was E. According to the assay test for Atorvastatin content, brand E was not in the acceptable range and brands D and E also showed minor impurities. According to the Pharmacopoeia standards, brands D and E were not in acceptable range in quality assessment tests. So their therapeutic values may lower than other brands of ATV-Ca.

Cytokine profiles in cutaneous leishmaniasis patients in Sri Lanka

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Cytokines play a vital role in the host immune response to infection and initiating the healing process and/or progression of the disease in cutaneous leishmaniasis (CL). No information is available in cytokine profiles and their regulatory function in CL patients in Sri Lanka. Therefore, the aim of this study was to determine the cytokine expression pattern of IFN-γ, IL-4, IL-11 and IL-12 in CL patients.

Patients with suspected CL lesions attending to dermatology clinic in Anuradhapura Teaching Hospital were included in the study. Patients who had less than six months old lesions were defined as acute lesions and over six months old lesions were considered as chronic lesions. Fifty seven biopsy samples were obtained from CL patients and control group. RT-qPCR was performed to determine the relative expression level. Data were analyzed using SPSS version 20.

The expression level of IFN-γ, IL-4, IL-11 and IL-12 were significantly high in CL patients irrespective of the duration (acute or chronic) of lesions compared to control (IFN-γ: median 18.20, inter-quartile range 4.65-47.13, $p<0.001$ for ACL and 153.28 (50.56-461.40), $p< 0.001$ for CHL; IL-4: 3.10 (1.51-10.67), $p = 0.008$ for ACL and 6.28 (1.16-21.86), $p = 0.003$ for CHL; IL-11: 2.50 (1.13-8.27), $p = 0.040$ for ACL and 3.81 (0.81-16.11), $p = 0.025$; IL-12: 3.87(1.56-14.03), $p = 0.012$ for ACL and 5.10 (2.99-32.22), $p= 0.002$ for CHL).

It can be concluded that the expression levels of all cytokines tested in the present study are significantly (<0.05) high in all CL patients. Therefore, the results suggest that Th1 response (IFN-γ and IL-12) is more prominent compared to the Th2 (IL-4) response in skin lesions of CL patients.

Traumatic dental injuries in children treated at the Division of Paedodontics, Faculty of Dental Sciences

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Traumatic Dental Injuries (TDI) are common among children and may occur throughout life. The main etiological factors are falls, fight and sports. Recent studies have shown that TDI are on the rise and are the third most common cause for mortality of teeth. This survey was aimed at assessing TDI in children treated at the Faculty of Dental Sciences. Records of student treated cases of dental trauma in patients aged between 6 and 16 years attending the Paedodontic clinic from January-2013 to December-2015 were surveyed. A pre tested questionnaire was used to retrieve the needed information. Data were analysed using the Statistical Package for Social Sciences, Version 17.0.

Hundred and eighty eight (188) traumatized teeth were observed in 104 child patients. A higher tendency of TDI was observed in boys (Male to Female ratio of 3:1) and at the age of 10-11 years (39.4%). The upper anterior teeth were mostly affected (90.9%) and the most common teeth involved were the upper permanent central incisors (82.9%). The leading etiology for TDI was accidental fall at home (36.5%) followed by fall at school. Uncomplicated crown fracture was the commonest injury to teeth (53%) while subluxation was the commonest injury to the periodontium (60%). Surprisingly, only 10% of patients sought treatment immediately. Out of all affected teeth, 40 teeth needed immediate pulp therapy but only 3 teeth had been treated with pulp therapy.

Consistent with many studies, TDI are three times more frequent in males and accidental fall (90.4%) was found to be the most frequent cause. TDI mainly occurred at home (36.5%) and is in accordance with the study done by Osuji. Only 1/3 of the patients sought dental treatment within 24 hours of TDI. This is low, but better than what has been found by Osuji in Nigeria (11%).

Seeking early treatment is crucial as long a post – traumatic period has been reported to require more complicated or extensive treatment than those presented within a short time.

Modelling of the pelvic surface dose during chest radiography in female paediatric patients at a selected hospital

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Two hundred chest X-ray examinations in female patients of paediatric age group (below 12 years) were studied. An electronic pocket dosimeter was used to measure the surface scattered radiation dose to the pelvis. It was placed immediately above the symphysis pubis. The direct radiation dose to the chest area was also measured. A pre-coded data sheet was used to collect data. The explanatory variables, age, Body Mass Index (BMI), milli Ampere (mA), kVp, average thickness of the body, inverse of square distance between the lower border of the primary beam and the sensitive region of the dosimeter, direct surface radiation dose to chest area and scatter surface radiation dose to the pelvic area were collected in the four month period. The correlation between the explanatory variables was analyzed statistically by using Pearson correlation. The aim of the study was to develop a model to incorporate scatter surface radiation dose to the pelvic area from explanatory variables.

The mean patients' age was 3.96 years ($\pm$ 2.956SD) and mean value of BMI was 15.7815 ($\pm$0 .7694). The mean values of mA was 397.60 ($\pm$68.187SD), direct surface radiation dose to chest area was 13.14 µSv ($\pm$ 3.530SD) and scatter surface radiation dose to the pelvic area was 0.834 µSv (0$\pm$.4514SD). According to results, the pelvis surface radiation dose during the chest radiography in female paediatric imaging was less than 1 µSv. It is evident that multiple regression model was inscribed inverse of square distance between the lower border of the primary beam (β=0.271), mA (β=0.262), and the direct surface radiation dose to the chest area (β=0.482) in the predicting scatter surface radiation dose to the pelvic area (R_{Adj} =0.319). There were markedly positive linear regressions to the scatter surface radiation dose with direct surface radiation dose and mA, but it was negative with the kVp.

Evaluation of AGD in digital breast tomosynthesis relative to those in two-view full field digital mammography

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Digital Breast Tomosynthesis (DBT) is performing in high resolution limited angle tomography at radiographic dose levels. Advanced system facilitates the DBT along with 2 view Full Field Digital mammography (FFDM). The objectives of this study were to compare the Average Glandular Dose (AGD) of DBT and FFDM and to calculate the percentage of radiation dose reduction when using DBT when compared with FFDM. The study was carried out using data base of DBT system in a private hospital. In the investigation we analyzed the dose of 251 patients who underwent mammographic examinations of both FFDM and DBT. All data analyses were done using IBM SPSS statistical software version 20.0. P-value of 0.05 was considered as statistically significant. The explanatory variables were age, breast thickness, kVp, mAs, target/filter combination, and AGD values of DBT and FFDM. Mean values for the patient age and compressed breast thickness were 50 years and 49 mm ($\pm$11.9SD) respectively. The majority of the images were acquired using W/Rh target/filter combination and 51% patients came for the diagnostic mammograms and 49% for screening mammograms. A wide kVp range was observed for DBT than FFDM while mAs range was lower in DBT. According to the results total average glandular dose (TAGD) from FFDM and DBT for diagnostic was 4.21mGy ($\pm$1.46SD), for screening 4.04 ($\pm$1.31SD) and there was a statistically significant difference between mean values of TAGD. Mean AGD for Mediolataral Oblique (MLO) view in DBT was 2.05mGy ($\pm$0.60SD), in FFDM 2.73mGy ($\pm$1.02SD). AGD for Craniocadal (CC) view in DBT was 1.63mGy ($\pm$0.36SD) and for FFDM it was 1.83mGy ($\pm$0.66SD). AGD to the breast from DBT was significantly lower than that for FFDM while range was lower in FFDM than DBT. There was a significant difference between mean values of CC and MLO views in DBT and FFDM ($P<0.05$). It was evident that AGD from DBT was lower than that for FFDM further AGD was reduced by 55.3% by using DBT with compared to TAGD, using both FFDM and DBT together for same patient and AGD was reduced 19.19% by using DBT when compared to AGD from FFDM.

Quadriceps angle of undergraduate students of University of Peradeniya

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Q angle (Quadriceps angle) is formed between two intersectional lines, one passing between the anterior superior iliac spine (ASIS) to the midpoint of patella and the other from the tibial tubercle through the midpoint of patella. It represents the alignment of quadriceps with the patella ligament. Greater Q angle increases the lateral pull of patella tendon which causes increased tensile stress on the soft tissue in the medial side of the knee joint causing patellofemoral pain, patella subluxation and dislocation. Unequal pull may drag patella over lateral femoral condyle and may cause chondromalacia patellae. Therefore Q angle values are important in the assessment of knee joint biomechanics. Nevertheless normative values vary according to the method used in quantification. It varies between populations too. Further it shows bilateral variation and sexual dimorphism. Therefore it is important to understand Q angle values related to Sri Lankan populations and to establish a standard simple method that could be easily replicated in clinical practice for its evaluation.

A descriptive cross sectional study to quantify the Q angle was conducted among healthy residential undergraduate students of university of Peradeniya. Measurements were done using a goniometer when the subjects were standing in Rhomberg stance on a flat surface with quadriceps and glutei were relaxed. Two sample t-test was used to analyze differences between groups.

Study population included 220 female students and 143 male students with a mean age (SD) of 23.6(1.6) years. Mean Q angle values (SD) were 20.380(4.1) and 11.860(3.5) for males and females respectively and the difference was significant. A significant bilateral variation too was observed among males.

Average Q angle values reported here were greater than the values considered as normal in clinical practice. As described in previous studies sedentary lifestyle induced body types of this academically oriented group may explain these differences. Wider pelvis places the ASIS farther away from the patellar midline. This may explain the greater Q angle among females. Quantification of Q angle in the standing position reflects the functional status of the knee while the Rhomberg stance is easily replicated and minimizes the measurement errors.

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Diabetes mellitus and cardio vascular disease among undergraduates of University of Peradeniya

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Diabetes mellitus (DM) and cardiovascular diseases (CVD) are becoming common conditions worldwide, from which Si Lanka is no exception. Some of the risk factors for DM and CVD are modifiable. If such modifiable risk factors are identified and eliminated early, the incidence of DM and CVD can be reduced. Therefore, this study was planned to estimate the prevalence of cardio- metabolic risk factors among undergraduates of the University of Peradeniya.

In this study 116 students from the Faculty of Allied Health Sciences (AHS), 169 from Faculty of Arts (ART) and 114 from Faculty of Veterinary Medicine and Animal Science (VET) voluntarily participated. All participants visited a mobile health clinic, after a 12-hour fasting period. They, after giving written consent, filled a questionnaire after which their height, weight, waist circumference (WC) and blood pressure (BP) were measured. Venous blood samples were collected and fasting blood glucose (FBG) level and lipid profile were measured using commercially available test kits. Their Body Mass Index (BMI), WC, BP and laboratory test results were interpreted according to the established standard criteria.

Though DM (ART- 1.2%) and impaired fasting glycaemia (AHS- 1.7%, ART- 2.3%) appear to be low among this group, a substantial proportion showed low or borderline high density lipoprotein (AHS- 80.2%, ART- 80.4% and VET- 89.5%) with high or borderline total cholesterol (AHS-20.7%, ART- 29.7% and VET- 20.2%), low density lipoprotein (AHS- 25%, ART- 27.6% and VET- 27.2%) and triglyceride level (AHS-16.4%, ART- 6.1% and VET- 14.0%) values.

Since the potential risk factors such as stress (AHS-81.9%, ART- 76.3% and VET- 70.2%), lack of exercise (AHS-74.1%, ART- 68.6% and VET- 50%) and first degree family history for cardio- metabolic diseases (%) with the presence of other risk factors such as being overweight (AHS-11.2%, ART- 10% and VET- 15.8%), obesity (AHS-2.6%, ART- 1.8% and VET- 2.6%) and abdominal obesity (AHS-6.9%, ART- 3% and VET- 1.8%) could lead to cardio- metabolic diseases in these undergraduates if any preventive action is not adopted soon.

Abstract No: 505   *Health Sciences*

Knowledge, attitudes and practice of self-administration of insulin by patients with diabetes mellitus followed up at the General Hospital (Teaching), Kandy.

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Diabetes mellitus (DM) is recognized as one of the leading causes of death and disability worldwide. Most patients with type 2 diabetes eventually fail to respond adequately to oral hypoglycemic drugs and require insulin therapy. The present study was carried out to assess knowledge, attitude and practice of Self Administration of Insulin (SAI) among a cohort of 280 patients attending diabetic clinic of general hospital (Teaching) Kandy.

Patients with type 1 and type 2 diabetes mellitus attending the diabetic clinic at the general hospital (Teaching) Kandy within the period of July to November, 2015 were used for the study. Data were collected through a pre-tested interviewer administered questionnaire prepared in both Sinhala and Tamil media.

The age of the participants ranged between 18 and 55 years. Of 280 patients, 173(61%) were females while 107 (38%) were males. Knowledge assessment on Self administration of Insulin revealed that 76 (27%) of the participants possessed poor knowledge on SAI while 166 (59%) possessed an average knowledge. Thirty eight (13.6%) possessed good knowledge on SAI. This study showed that the knowledge on SAI correlated well with educational level, occupation, nationality and monthly income while the attitude of the patients on SAI correlated with educational level, nationality and duration of insulin usage. It was further revealed that a vast majority of the participants was in the habit of changing their injection site. Furthermore, it was observed that most of them frequently used abdominal wall as the site of insulin administration.

This study concludes that majority of the diabetic patients participated in the study possessed average knowledge on SAI. Nearly 52% of the patients exhibited a positive attitude of the patients with diabetes on SAI. These findings of the present study highlight the importance of health education programmes on insulin therapy in order to improve the knowledge on self-administration of insulin.

Trend of mammography screening and distribution of risk factors among asymptomatic group of women in Kandy District

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Breast cancer ranks the highest among all forms of female cancers in Sri Lanka and amounts to 26%. Early detection through screening with mammography for breast cancer has been recommended for many decades. Aim of this study was to assess the frequency of screening mammography among the subjects and to assess the distribution of risk factors among the subjects who underwent screening mammography.

Asymptomatic women who attended for screening mammograms in mammographic facility in Kandy District were included as subjects. The data on risk factors such as age, hormone replacement therapy (HRT), parity, age at menopause, age at menarche and family history of breast cancer and the number of mammographic views per subject were obtained from the archives. The statistical package SPSS version 20.0 was used in the above analysis.

Among 2980 subjects, 78.4% had undergone only one-screening session. Frequencies of screening sessions 2, 3, 4, 5, >5 were found to be 14.1%, 3.6%, 1.4%, 0.8%, 0.6% respectively. Among the study groups, 40-49 age groups has shown higher tendency to undergo screening mammography (46.3%) and women aged 50-69 years showed nearly 40% (39.9%). Frequency of subjects with risk and no risk according to different risk factors: age, age at menarche, age at menopause, HRT, family history, parity were 5.9% vs 94.1%, 8.7% vs 89.6, 2.6% vs 87.5%, 2.7% vs 97%, 16.0% vs 81.8% and 9.7 vs 85% respectively.

Many studies have shown that routine mammography screening can achieve a breast cancer mortality reduction benefit. According to world literature, National Cancer Institute in United States recommends mammograms every 1 to 2 years for women aged between 40-49 years and annual screening for women aged 50 years and older. In conclusion, the highest frequency of women who attended screening sessions were aged between 40-49 years which is dissentient with the guidelines of National Cancer Control Programme in Sri Lanka which recommends the screening mammography for women who aged between 50-69 years. The risk factors given in the Sri Lankan guidelines did not show any effect on the frequency of the screening sessions. Therefore, it can be considered that the above risk factors had no greater impact on the influence on women to be motivated to undergo screening mammography.

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Health Sciences

Prevalence of risk factors of breast cancer among females of Yatinuwara Divisional Secretariat area in Kandy district

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Breast cancer is the commonest malignancy among females accounting for 23 % of all cancers in women worldwide. The etiology of breast cancer is unknown; but numerous risk factors have been identified. There are many categories of risk factors of breast cancer. One such category classifies them as environmental and hereditary factors. Another has categorized them as avoidable and non-avoidable. By making women aware of these, it is possible to expect higher rate of early detection leading to reduced morbidity and mortality.

Therefore, this research was designed to find out the prevalence of known risk factors among women in Yatinuwara Secretariat area in Kandy District. Further, local data on risk factors are sparse on this commonest cancer.

This is a community based descriptive study conducted in Yatinuwara Divisional Secretariat in Kandy District. A sample of 1200 was selected randomly from the selected 30 Grama Niladari Divisions. Women aged between 35-70 years, registered in the voters list and residing there for more than one year were selected as the study population. Women who were residing for less than one year and women with physical and mental disabilities were excluded. Standardized self-administered, pretested questionnaire was used to collect data.

52.7% of the sample had risk factors considered in this study. Among them 30.9%, 16.8%, 3.9%, 0.9% had one, two, three and four risk factors respectively. Only 0.1% had five or more risk factors. Most frequently identified risk factor was having one child or being nulliparous (19.2%). Second and third commonest factors were breast feeding for less than 24 months (11.4%) and age at menarche below 11years (7.6%). Contribution of risk factors such as use of oral contraceptives, age at first child birth and family history of breast cancer were 6.6%, 4.9%, and 5% respectively. Other factors such as age at menopause, family history of ovarian cancer, past breast cancers and duration of breast feeding contributed to either 1% or less than 1%. Body mass index (BMI) contributed to 5.7% as a risk factor.

Prevalence of risk factors was 52.7% among the study sample. Commonest risk factor identified in this study was having one child or being nulliparous.

Morphometric assessment of cranio-facial complex of a group of Sinhalese in Sri Lanka

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Morphometric studies have revealed cranio-facial differences among different populations, age groups and between the male and female. Therefore, the aim of this study was to establish normative values for twenty four cranial and facial measurements in a Sri Lankan Sinhalese population and to ascertain the differences between genders.

A cross sectional analytical study was carried out using 220 individuals of 20-25 years of age using a multistage stratified cluster sampling method. The sample consisted of 81 males and 139 females. Twenty four craniofacial measurements were taken and recorded in millimeters using standard anthropometric instruments. They were cranial (cranium circumference, head breath, head width and forehead heights of the cranium, skull height, and calvar height), facial (upper face heights, middle face heights, lower facial height, and facial width), nasal (nasal lengths, nasal root, nasal width, tip protrusion, alar length, and columella length), and soft tissue measurements (eye fissure width, lower lip thickness, total lip thickness, ear length on right and left, mouth width, and the interocular distance). Statistical analysis was done using SPSS software.

According to the results the measured variables excluding skull height, calvar height, mouth width and interocular distance were significantly higher in males than in females (p<0.05).

The present study could be used in forensic anthropology establishing ancestral relationships, and reconstructive cranio-facial surgeries among adult Sinhalese population in Sri Lanka. Since the present study is based on a small sample further studies are recommended to increase the statistical power.

Retrospective analysis of demographic findings and concordance between clinical and histopathological diagnosis of radicular cysts

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Radicular cyst is an odontogenic cyst of inflammatory origin that occurs in relation to non-vital teeth. Large radicular cysts associated with non-restorable teeth are generally enucleated. Although, clinical and radiological findings are adequate to provide a provisional diagnosis of radicular cyst, submission of enucleated specimens for histopathological confirmation is mandatory to rule out other pathologic processes.

The aims of this retrospective study were to present the demographic findings namely, age, gender and site distribution of radicular cysts and to present the level of agreement between clinical and histopathological diagnoses achieved for radicular cysts.

Four hundred and eleven cases of histopathologically confirmed radicular cysts, diagnosed during a period of 5years from 2011 to 2015 were available for the analysis. In addition, further eighty cases with the clinical diagnosis of radicular cysts that were histopathologically diagnosed as different pathologic entities were used to assess the level of agreement between clinical and histopathological diagnoses.

Out of the 411 radicular cysts, 2.4% (10) lesions occurred in the deciduous dentition, while a majority (97.6%) of lesions affected the permanent dentition. The majority (73.2%) of radicular cysts occurred in adults between 21-60 years, while 10.9% (45) and 10% (41) occurred in children and elderly patient respectively. Male predilection with male to female ratio of 1.5:1 was observed. Interestingly the majority (83.7%) of radicular cysts had occurred in the maxilla compared to 16.7% (67) in the mandible. Out of the 411 histopathologically confirmed radicular cysts, 342 had been correctly diagnosed clinically, achieving a rate of agreement of 83.2%. Out of the 422 with a clinical diagnosis of radicular cysts, only 81.1% were confirmed histopathologically. Of the remaining 80 lesions with a clinical diagnosis of radicular cyst 2 lesions were diagnosed as malignancies, 39 as odontogenic tumours, 27 as odontogenic and non-odontogenic cysts of developmental origin and 6 as periapical abscesses.

In conclusion, although good agreement is observed between clinical and histopathological diagnosis of radicular cyst, it is mandatory to histopathologically confirm the diagnosis of radicular cyst, as approximately one fifth of the clinically diagnosed radicular cysts may in fact be tumours or malignancies that require different management strategies.

Clinical presentations and management strategies of patients with oral lichen planus attending the Dental Teaching Hospital, Peradeniya

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Oral lichen planus (OLP) is a chronic inflammatory mucocutaneous disorder affecting 0.5- 2.2% of the population.

Patients with OLP who presented to the Oral Medicine Clinic (OMC), Dental Teaching Hospital, Peradeniya from year 2000-2015 were included to this study. Clinical, histopathological and follow up data were gathered. The minimum follow up period was one month. All cases were classified clinically according to the classification of Andreasen.

There were 361 females and 159 males with the male to female ratio of 1:2.3. The mean age at presentation was 45.11 years for males and 45.13 years for females. Age at diagnosis ranged from 8 to 89 years with a mean age of 45.13 years. The majority of patients were Sinhalese (88.5%). Reticular type was the commonest clinical type and accounted for 28.4% whilst buccal mucosa was the commonest site involved. Of the sample, 0.8% was treated with Chlorhexidine mouth wash and a mild topical corticosteroid whilst 35.4% were treated with Chlorhexidine mouth wash and a moderate topical corticosteroid drug. Intralesional corticosteroid drugs were used for 16 patients to relieve symptoms. Only 8 patients were managed without drugs. Complete resolution of symptoms was observed in 6% and the majority of patients had indicated that their symptoms had reduced (80%). A statistically significant association was found between age group and intra oral sites ($p<0.001$). No statistically significant association was observed between gender and clinical sub types ($p=0.06$) and also with type of treatment and outcome.

Histopathologically, epithelial dysplasia was present in three cases at the initial diagnosis and these cases were followed up for 15, 17 and 35 months and they did not show malignant transformation (MT). Two cases of OLP without dysplasia at initial diagnosis later showed MT. They developed squamous cell carcinoma after 26 and 35 months.

In conclusion, gender (female predominance), site (buccal mucosa) and type of OLP (reticular lesions) support findings from international literature. OLP is a condition with a low MT rate which requires long term follow-up even in the absence of dysplasia in the initial biopsy.

Fractures of acrylic dentures: an analysis of patterns and associated factors

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Acrylic resin (polymethylmethacrylate) is the material of choice in fabrication of complete denture bases and it is also commonly used for removable partial dentures especially in developing countries such as Sri Lanka due to economic reasons. Due to the low strength of the acrylic resin material, one of the commonest denture complaints is fracture of acrylic dentures. Therefore, this study aims to explore the pattern and associated factors of complete and partial acrylic denture fractures.

In this cross sectional pilot study, 110 removable acrylic denture wearers complaining of denture fractures were selected. An interviewer-administered questionnaire was used to collect data on types and causes of denture fractures and their associated factors. The denture examination and intraoral examination were carried out. The findings were statistically analyzed.

Out of the dentures that were examined, 39% were complete dentures and 61% were partial dentures. The most commonly (34%) fractured dentures were upper partial dentures. The commonest type of fracture was fracture of the denture base. When considering all the dentures, 51% of the fractures occurred during mastication. A significant correlation was found between the denture fractures and the age of the denture. Midline was the commonest fracture site in complete dentures.

With the findings of this pilot study, it is presumed that the most commonly fractured dentures are upper partial dentures and a majority of denture fractures are caused during mastication. There was a statistically significant correlation between denture fractures and denture age. However, analysis of a larger sample is needed to arrive at conclusions regarding denture fractures and their associated factors.

Expression of p16 gene in oral potentially malignant disorders and oral cancer- a preliminary study

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Oral squamous cell carcinoma (OSCC) is considered an important part of the global burden of cancer. Human Papilloma Virus (HPV) infection has been increasingly recognized as a major etiologic factor for a subset of oral cancer and Oral Potentially Malignant Disorders (OPMD). Although down regulation of p16[INK4A] in cancer did not increase p16 over expression, high-risk HPV related oral cancers showed increased expression of p16 protein.

A total of 68 formalin fixed paraffin embedded biopsied samples diagnosed as OSCC and OPMD were retrieved from the archives of the Department of Oral Pathology, Faculty of Dental Sciences, University of Peradeniya. Expression of p16 was investigated by immunohistochemistry (IHC) using p16 [INK4A] monoclonal antibody. The sample consisted of 9 OSCC, 21 Oral Submucous Fibrosis (OSF), 25 Oral Lichen Planus (OLP) and 13 cases of Keratosis with dysplasia. Cervical carcinoma was taken as the positive control and PBS used for the negative control without primary antibody. Stained slides were evaluated by 2 examiners separately and nuclear positivity of more than 1% was considered as positive.

Out of all cases 16.17% were positive for p16 protein. Expression of p16 in OLP was 20% followed by 14.28% in OSF and 15.38% in keratosis with dysplasia. Only one OSCC case was positive (11.1%) for p16. Average expression of p16 in all the cases was 8.71%.

HPV is believed to promote the oncogenic process and the relationship between viral onco-proteins and down regulation of p16[INK4A] tumour suppressor protein in oral lesions. This preliminary study showed 16.17% oral cancer and OPMD were positive for p16 gene expression. Expression of p16 protein is higher in OPMD when compared with OSCC.

The findings of our study as well as published data in the literature suggest that, inactivation of p16 occur at the very early stage of oral cancer in the multistep process of oral cancer progression, before the acquisition of an invasive phenotype. Therefore, loss of p16function in precancerous oral lesions may be considered as a prognostic marker for the progression of malignancy. Further studies are necessary with a larger sample and extended molecular studies to confirm the results.

Abstract No: 535   *Health Sciences*

Histological parameters and expression of EGFR and β – catenin in oral squamous cell carcinoma; a preliminary study

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The incidence of oral squamous cell carcinoma (OSCC) remains high and it is ranked as the 6th commonest cancer globally. Although the presence of neck lymph node metastases at the diagnosis can decrease the 5-year survival rates to lower than 50%, treatment of the clinically-negative neck is still controversial. Invasive front of the cancer is known to be important in predicting metastasis and prognosis thus the use of molecular markers together with traditional histological methods may improve the strategy for comprehensive management of patients with OSCC. This study is aimed to analyse the expression of Epithelial Growth Factor Receptor (EGFR) and β – Catenin molecules with histological parameters and demographic data.

A total of 39 OSCC cases treated with excision and neck dissection at Oral Maxillofacial units in Sri Lanka were assessed for pattern of invasion, tumour stage, level of differentiation, expression of EGFR and β – Catenin. Demographic data was obtained from Oral Pathology database and histological materials were collected from the archives in the same Department. Data were analysed using SPSS version 16.

A statistically significant expression of EGFR was observed with pattern of invasion ($p<0.05$). As the sample size was small, a significant/reliable relationship could not be established with metastasis for the same. Overall β – Catenin expression was low in cancer cases and showed no significant association with pattern of invasion or metastasis. A significant positive relationship between the pattern of invasion and metastasis ($p<0.05$); and between the host response and survival rate ($p<0.05$) were observed.

EGFR is a reliable candidate molecule to be used in combination with histological parameters to predict prognosis of OSCC. As this is a preliminary study which however used a panel of different molecules to assess the advancing front of the cancer, a larger sample needs to be tested to draw safe conclusions before making recommendations for the clinicians.

Abstract No: 539 (Poster)   *Health Sciences*

A preliminary study on antimicrobial activity of traditional and contemporary betel quids used in Sri Lanka

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Betel chewing has been practiced by Sri Lankans since ancient times. Chewing of traditional betel quid (TBQ) containing betel, herbs such as clove, nutmeg, cardamom, arecanut, coriander, and ginger is known to support oral health. However, beneficial effects of TBQ are not scientifically proven yet. TBQ has remarkably transformed to contemporary betel quid (CBQ) which is now identified as a major risk factor for the development of oral cancer with the introduction of tobacco and slaked lime. The present preliminary study aimed to demonstrate the antimicrobial activity of TBQ and CBQ.

Betel quids were prepared by mixing equal weights of dry ingredients and extracted in ethyl acetate in a soxhlet apparatus and dried in a rotary evaporator. Extracts were dissolved in dimethyl sulphoxide (DMSO) and tested for dose dependant antimicrobial effects by agar well diffusion method against three common pathogenic bacteria; *S. aureus, E. coli,* and *P. aeruginosa,* and five *Candida* species; *C. albicans, C, galbrata, C. parapsilosis, C. tropicalis*and *C. krusei.* DMSO was used as the negative control. Gentamicin and fluconazole were used as positive controls.

Our results revealed that ethyl acetate extracts of both TBQ and CBQ have inhibitory effects against *S. aureus*, *E. coli,* and *P. aeruginosa*. CBQ extract showed a significantly larger zone of inhibition for *S. aureus* (18mm) than for *E. coli* (15.3±0.6mm) and *P. aeruginosa* (13.7±1.5mm) at the highest concentration tested (30 mg/ml). At the same concentration, TBQ extract showed significantly larger zones of inhibition for *S. aureus* (16±1mm) as well as for *E. coli* (14±1mm) than for *P. aeruginosa* (11.7±0.6mm). However, there was no inhibitory effect of TBQ and CBQ extracts against any of the *Candida* species tested.

Accordingly, it is concluded that TBQ and CBQ have antibacterial activity against *S. aureus*, *E. coli,* and *P. aeruginosa* while they have no inhibitory effect on *Candida* species at the concentrations tested in this study. Further studies are warranted to demonstrate the effects of TBQ and CBQ against oral bacteria.

Antioxidant activity of the herbal ingredients in traditional betel quid

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Since ancient times, chewing of traditional betel quid (TBQ) is believed to strengthen teeth and gums and also control caries, periodontitis and bad breath. However, these effects are not scientifically elucidated yet. Since herbal ingredients are well documented to be rich in antioxidants which can scavenge free radicals involved in pathophysiology of many oral diseases, we analyzed the antioxidant activity of the TBQ and its individual ingredients.

TBQ prepared by mixing equal dry weights of its ingredients and the individual ingredients were extracted in ethyl acetate and tested for in vitro antioxidant activity using ferric reducing antioxidant power (FRAP) and DPPH radical scavenging activity.

Our results revealed that the antioxidant activity of TBQ is significantly higher than the sum of the antioxidant activities of individual ingredients (FRAP of TBQ = 1292.8±39.7 mmol/ml, sum of the individual ingredients = 204.5±9.5mmol/ml and DPPH radical scavenging activity as IC_{50} of TBQ =83.5±1.04 µg/ml, sum of the individual ingredients 686.1 µg/ml±14.7) suggesting synergistic interactions among the individual ingredients in the TBQ.

Retrospective analysis of keratocystic odontogenic tumours in a cohort of Sri Lankan patients

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Keratocystic odontogenic tumour (KCOT) is a benign multicystic, intraosseous tumour of odontogenic origin, with a characteristic lining of parakeratinized stratified squamous epithelium and potential for aggressive, infiltrative behavior. It is occasionally associated with Gorlin Goltz syndrome (GGS). Although studies and analyses are available for western populations with regards to KCOT and its association with GGS, there are no reported studies for Sri Lankan (SL) patients where clinical features and behavioral pattern might differ from the western populations. Sri Lanka is considered as a country with different geo-genetic background and the aim of the present study was to analyze the clinical presentation and to compare with western data.

This was based on 274 cases reported to the Department of Oral Pathology, Faculty of Dental Sciences, University of Peradeniya, from 2003 to 2016. Demographic data, clinical presentation and histopathological features were analyzed. Four cases were ortho-keratinizing odontogenic cysts and were excluded from the study. The data were analysed using SPSS 20.0 statistical software.

In this analysis 154 (57%) were males and 116 (43%) were females with the male to female ratio of 1.32:1. Age range varied from 7 to 84 years with a mean age of 35.46 years. The mandible (77.1%) was more commonly affected than the maxilla (22.1%) and only 0.8% occurred in both jaws. The right side showed a slight preponderance (48.3%) compared to the left side (43.9%). Three cases out of five multiple KCOTs were associated with GGS (1.1%). Histopathologically 8 cases showed morphological variations. Four cases (1.5%) transformed in to squamous cell carcinoma and three cases demonstrated dysplastic features. One case transformed into conventional ameloblastoma which is an odontogenic tumour that can be locally aggressive.

Pattern and behavior of clinical features of KCOT in the Sri Lankan context is in par with the English Literature. Regular follow up is important due to the high chance of malignant transformation compared to other tumours. Further it is necessary to investigate for the Gorlin Goltz syndrome when a patient presents with multiple KCOT.

Correlation between different methods of working length measurement in root canal treatment

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Endodontic working length can be measured using apex locators, working length radiographs and also digital radiographic software. Apex locators are capable of identifying apical constriction using sinusoidal waves of different frequencies. Radiographic working length is usually calculated by inserting a file with a known length and reducing 0.5mm from the length of the tooth as appearing on the radiograph. It is usually taken as the final working length measurement. Digital radiographic software could be used to estimate the working length with a measuring tool by drawing a line from coronal reference point to the apical constriction. This could be measured with or without calibration. Software working length is measured without calibration in this study. The aim of the study is to assess the correlation between different methods used in estimation of the working length during root canal treatment.

Working length data were analyzed from SPSS 20.0 software by using paired sample t-test, Pearson Correlation and calculated ranks of Wilcoxon Signed Rank test. According to the paired sample t-test, both means of apex locator and software working lengths did not show a significant difference to the mean of the final working length (p-value: 0.205, 0.444 respectively). According to Pearson Correlation, apex locator and final working length are strongly correlated (r=0.868), while software working length and final working length are moderately correlated (r=0.623).

According to this study, the use of apex locator readings is the most dependable compared to software working length. Further research is needed to evaluate the use of calibrated software working length, which theoretically appears to be a predictable method.

Abstract No: 549 (Poster)   *Health Sciences*

Evaluation of treated traumatic dental injuries at 6 months follow up in a group of children

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Traumatic dental injuries of the permanent dentition are common among children all over the world, leading to significant health and social problems. Management of traumatized teeth is challenging, as this requires accurate diagnosis, prompt treatment planning and pertinent clinical skills. Long term follow-up is essential since complications can arise even several years following treatment. The objective of this study is to evaluate treatment outcome at the six month review appointment in a group of children treated at the Division of Paedodontics, following trauma to the permanent dentition.

A retrospective study was conducted at the Division of Paedodontics, Dental Hospital –Peradeniya, with the use of clinical records of patients who had undergone traumatic dental injuries during the year 2013 to 2016 time period. The sample consisted of 104 patients involving 188 traumatized teeth, but out of those patients, the turnover at the 6 months follow-up visit was only 23% (24 patients, 52 teeth). Data analysis was done with the use of SPSS 17.0 statistical software.

Out of the total 52 teeth, 38.5% had open apices and 78.8% were vital, even though 65% of them were delayed presentations. Uncomplicated crown fractures (25) were treated with composite build-ups, among which 96.42% gave a vital response at the 6 months review visit. Calcium hydroxide pulpectomies were carried out on 4 teeth with complicated crown fractures as those children presented late with non-vital teeth. Out of the 9 luxated teeth (concussion-4 & subluxation-5), 8 teeth gave vital responses on the initial visit and all these teeth remained vital at the 6 months review visit. Splinting was done only for 1 tooth with subluxation, while antibiotics were prescribed to most of the children with periodontal injuries. Compared to the management of teeth with single injuries, the management of teeth with multiple injuries was complicated and they showed poor prognosis.

The results of this study indicated a statistically significant low turnover ($p < 0.5$) for the review appointment at six months, even though long term follow-up is mandatory. Hence, public awareness on prevention, quest for immediate treatment and necessity for long term follow-up following dental trauma should be emphasized and promoted.

Evaluation of cancer stem cell marker expression as a tool to predict survival and nodal metastasis of patients with oral squamous cell carcinoma

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Oral squamous cell carcinoma (OSCC) is the commonest malignancy, in Sri Lanka, contributing to 19.5% of all cancers detected in both sexes. The aim of the study was to correlate the survival of OSCC in a group of Sri Lankan patients with the expression patterns of five CSC markers namely ALDH1, SOX-2, Bmi-1, C-Met and Oct-4.

One hundred and forty OSCC patients with survival information, diagnosed during a period of 4 years from 2009-2012 were included in the study. Archival OSCC tissues from these patients were used for immunohistochemical investigations with CSC markers, ALDH1, SOX-2, Bmi-1, C-Met and Oct-4 were performed according to the manufacturer's instructions (Abcam Pvt Ltd, UK). Ten high power fields with the most number of positive cells were identified and counted with the average taken as the final score. A tumour was considered to express the CSC maker when >5% of the OSCC cells gave a positive reaction while tumours expressing <5% of positive cells were considered as negative. Survival analysis was performed with SPSS version 20, using Kaplan-Meier survival curves and significance with Chi square test and Breslows (generalized Wilcoxon) test.

The study sample comprised of 9.3% patients younger than 45 years while the rest were older than 46 years at the time of diagnosis. Male to female ratio was 2.8:1. Buccal mucosa was the commonest site of occurrence, contributing to 67.8% of OSCC, followed by tongue (23.6%). The majority (80%) of OSCC patients had TNM stage III or IV disease at diagnosis with 28.6% of patients presenting with pathological confirmed nodal metastasis. Immunohistochemical investigations revealed that 55.7%, 58.6%, 40%, 34.6% and 31.4% of OSCCs showed ALDH1, SOX-2, Bmi-1, C-Met and Oct-4 expression respectively. ALDH1 positivity was significantly associated with nodal metastasis (X^2 =4.6; P=0.03). Although, it did not reach statistical significance, ALDH1 expression was also correlated to poor survival (P=0.06). No statistically significant findings could be observed when the expression of other CSC makers were correlated with nodal metastasis and survival (P>0.05).

In conclusion, out of the five CSC markers investigated in the present study, only ALDH1 showed promise as a potential marker to predict nodal metastasis and survival in the present study sample of OSCC patients.

Survey on issues on sub-fertile couples attending the Teaching Hospital, Peradeniya

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Subfertility is usually defined as the failure of a couple to conceive after one year of regular unprotected intercourse. Subfertility is known to have adverse effects on health, finance, occupation, social, mental, and sexual health compared to a fertile counterpart. It is important to study it.

A descriptive cross sectional study was conducted among sub fertile couples coming to the ward 3 and the gynecological clinic in the Teaching Hospital, Peradeniya. Data collected by self-administered questionnaires, was analyzed by SPSS.

According to the study conducted, only 14% of the women were aged above 35y, whereas 43% men were above 35y. A majority of the women had passed A/L accounting to 43%. In contrast to that, a majority of the men's highest educational qualification was O/L: 39%. Interestingly 92% of women were unemployed, whereas 21% of men earned less than Rs. 20000. 42% of women and men were married for more than 5y.Another important point was that 64% women were having primary subfertility and only 28% of them did not have any medical advice up to this point. Also, 88% men had mumps. A majority of couples were from within 100km range from the hospital, and 71% of them were travelling by the public transport system.71% of husbands were coming to the hospital every time. A majority (78%) was spending less than Rs. 1000 for each visit.10% of women were found to have depressive features and major symptoms were low mood accounting to 32%.But 18% of men had depressive features and the most prevalent symptom was irritability. Good family support was received by 50% of the women and men.

This reveals a minority of sub fertile women have reached advance maternal age which would be a risk. A majority is having primary subfertility and some of them show a delay in seeking medical advice. Less research has been done on men's reactions to subfertility, but they tend to report experiencing less distress than women. In contrast to that, our study shows that men are having more depressive features because of subfertility.

Due to the nature of subfertility, attention to the quality of life by means of impact of sub fertility in these couples has equal importance to different treatment programs.

Nutritional status of schooling adolescents in Anuradhapura district-are we under-estimating obesity?

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Childhood under nutrition is a well-documented health problem in Sri Lanka, but little attention has been paid to childhood obesity in rural areas. This study was designed to determine the nutritional status of schooling adolescents in the Anuradhapura District with emphasis on defining obesity using different international and local definitions.

Students of grades 9–11 from 74 schools representing the district were selected. Socio-demographic data were obtained through a structured self-administered questionnaire. Anthropometric measurements were carried out according to WHO guidelines. Thinness and stunting were defined using WHO age and sex specific growth references. Obesity was defined using WHO growth references, International and Asian BMI cutoff values of IOTF and Indian BMI cutoff values. Prevalence of central obesity was determined using South Indian and British waist circumference (WC) cutoff values. Appropriate thresholds for waist to height ratio (WHtR) were analyzed using Receiver Operating Characteristics (ROC) curves.

A total of 3135 students were studied. According to WHO growth references, prevalence (with 95% confidence interval) of severe thinness, thinness, overweight and obesity for boys were 9.4% (8.0- 11.0), 19.6% (17.6-21.7), 7.7% (6.4-9.2) and 3.1% (2.3-4.1) respectively. For girls, they were 2.4% (1.8-3.3), 12.6% (11.1-14.3), 6.7% (5.5-8.0) and 1.7% (1.1-2.4) respectively. The prevalence of severe stunting and stunting were 2.5% (1.8-3.4) and 11.1% (9.6-12.8) respectively for boys and 1.0% (0.7-1.7) and 11.0% (9.5-12.6) respectively for girls. Boys had higher prevalence of severe thinness, thinness and overweight/obesity compared to girls. Severe stunting was more prevalent among boys than girls. The prevalence of overweight and obesity were higher while thinness and stunting were lower in type 1AB schools when compared to other types of schools. ROC curves for WHtR against four definitions of obesity, suggested a cutoff value around 0.46.

While thinness and stunting remain a considerable health issue among adolescents in the Anuradhapura District, there is evidence of rising incidence of overweight and obesity. The present study suggests a threshold of 0.46 for WHtR to diagnose obesity.

Abstract No: 558   *Health Sciences*

Antimicrobial activity of aqueous extracts of selected seaweeds against some human pathogens

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Infectious diseases contribute substantially to global human mortality and morbidity while the antimicrobials are being used to control those. However the evolution of antibiotic-resistant pathogenic bacteria has demanded to search for alternative antimicrobials. Seaweeds act as one of the good alternative solutions found from the ocean. In this study, antimicrobial activity of aqueous extracts of selected seaweeds was evaluated against some human pathogens.

Algal material of *Padina antillarum, Sargassum, crassifolium, Ulva lactuca* and *Halimeda opuntio* were collected from the coast of Koggala, Sri Lanka. Aqueous extracts of these seaweeds were prepared and tested for antimicrobial activity against five bacterial isolates: *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27852) and wild strains of methicillin resistant *Staphylococcus aureus*, clindamycin resistant *Staphylococcus aureus* and one fungal isolate: *Candida albicans* (ATCC 90028) using cut well diffusion and agar dilution methods.

Aqueous extract of *S. crassifolium* demonstrated growth inhibitory action against *S. aureus* (ATCC 25923) in cut well diffusion method while aqueous extraction of *U. lactuca* demonstrated growth inhibitory action against *S. aureus* (ATCC 25923), clindamycin resistant *S. aureus* and *C. albicans* (ATCC 90028) *in* agar dilution method.

These observations revealed the possible presence of water soluble antibacterial agent/s in *S. crassifolium* and *U. lactuca*. The fact that the lowest minimum inhibitory concentration for clindamycin resistant *S.aureus* was given by extracts of *U. lactuca,* indicated the potential to develop a new therapeutic agent. Therefore extensive studies are warranted to isolate active compounds in seaweed extracts using different methods and to test their potential to be used as commercial antibiotics.

Effects of dietary habits on red cell indices among female undergraduate students of the Faculty of Allied Health Siences, University of Peradeniya

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Lack of nutrients in a diet can lead to a number of disorders in the body. Micronutrient deficiencies and nutritional anaemia are major problems, especially among children and women in South East Asian countries including Sri Lanka. This cross sectional study was performed among 95 female undergraduates studying in the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka, in 2015. The objective of this study was to determine the effects of dietary habits on red cell indices.

Red cell indices were calculated using haemoglobin level, packed cell volume and red blood cell count which were determined by cyanmethemoglobin, microhaematocrit and counting chamber methods, respectively. A self-administered questionnaire was used to collect information regarding dietary habits. Descriptive statistical method, chi-square test, and independent sample t-test were used in the data analysis.

According to WHO standards, 30.5% (n = 29) of the current study population had normocytic normochromic (Hb < 12g/dl, MCV 80 - 100fl, MCH 27 - 32pg, MCHC 32 – 36%) condition and 6.3% (n = 6) had microcytic hypochromic (Hb < 12g/dl, MCV < 80fl, MCH < 27pg, MCHC < 32%) conditions. For MCV, MCH and MCHC 8.4%, 8.4% and 18.9% had lower values than the reference ranges while 4.2%, 10.5% and 5.3% had values higher than the reference ranges, respectively.

Less number of meals supplemented with meat, fish or eggs and high frequency of drinking tea per day showed a significant association ($p < 0.05$) with low MCV values ($p < 0.05$). Having MCH values lower than the reference range were significantly associated ($p < 0.05$) with low frequency of eating fruits and long duration (>5days) of menstruation. However, MCHC values did not show a significant association with dietary habits.

According to this study, the frequency of eating meat, fruits, drinking tea and the duration of menstruation demonstrate a significant impact on the red cell indices of this selected population. This warrants further studies on a larger population to validate these findings and eventually encourage the development of directed educational and nutritional programs.

Abstract No: 12   *IT, Mathematics and Statistics*

Production planning for a dairy product: a case study in Jaffna

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Dairy industry has a mature market within Sri Lankan economy. This study investigated the distributions of the demand of dairy production and prices of raw-materials to find the optimum amount of the dairy production which gives the maximum annual profit. A dairy industry which is located in Jaffna was chosen for this study. Despite having a variety of products which are manufactured in this industry, *lolly* which is a type of sweet ice juice made of milk, was selected due to its popularity among customers and it is considered as a strategic product to the industry. The collected data consist of customer demands, selling price, requirements of ingredients, raw-material prices, labour charges, electricity cost, holding cost and shortage cost. Data were collected in the time period from January 2011 to December 2015. The industry was looking for a production planning strategy which helps to gain a considerable annual profit. The collected data are analyzed in order to explore the distribution of the monthly demand for *lolly* and distribution of raw-material prices. Simulation technique was used to estimate the demand and raw-material prices considering their probability distributions. Monthly unit production cost, shortage cost and holding cost were calculated. This information was used to formulate a linear programming model for aggregate planning in which the optimum production for maximum annual profit could be obtained. The Solver built-in optimization tool of Microsoft Excel was used to find the maximum profit. The decision variables are required to be integer. Therefore, the number of products obtained could be approximated to integer quantities without affecting the implementation. The study showed that the implementation of the results can increase the net profit by selling *lolly*. Monthly demand follows a *normal distribution*. Raw-material price follows a *uniform distribution*. Findings from this work could serve as useful information to the management of the industry in the formation of production strategies for its *lolly* dairy product.

Yield optimization of chilli and string bean for different levels of spacing and organic fertilizer under intercrop and monocrop systems

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The scope of agriculture is the utilization of resources in the most efficient manner. In this respect, optimization of yield in agriculture crops is needed to safeguard the farmer by minimizing the cost. In the collaboration between operation research and agriculture lays a big step up of exploitation in upcoming epoch. Hence, a new study was carried out in yield optimization of chilli and string bean in alliance with goal programming forfeit a new way for the multiple objective aspirations. From the review of literature, it can be seen that the application of optimization models is comparatively less in scientific world. Therefore, the study which was carried out on agriculture crops was to optimize the yield of chilli and string bean with different levels of spacing and fertilizer under monocropping and intercropping systems. For the crop sustainability, *Azosprillum* mixed fertilizer was used to make the system as organic. Yield was optimized with application of input cost (weeding, land preparation, irrigation and planting materials) to find out the optimum yield over recommended yield through goal programming. Field plot was assigned in randomized complete block design with dimension of 3 meters length and 2 meters width. Total planting areas was assessed to be 648 square meters. Projected areas for each crop were 432 square meters. Projected areas for each system of intercropping and monocropping were 216 square meters. From this optimization model, plant number and planting material cost were reduced by 14.6 % and 14.3 % respectively. Total plant number was reduced by about 12.5 % in monocropping and 17.4 % in intercropping. Total recommended and optimized yield of green chilli under monocropping were 58 ton/ha and 51.25 ton/ha, respectively. Similarly, under intercropping, total recommended and optimized yield of green chilli were 28 ton/ha and 21.25 ton/ha, respectively. However, the recommended and optimized yield of string bean were 17.28 ton/ha and 14.9 ton/ha respectively under each system due to equal number of the population maintained in both systems. Further, the result of this optimization model is applied in field level to find out the variation.

IT, Mathematics and Statistics

Modeling and forecasting mortality rates: an application of the Lee-Carter model to Norway mortality data

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Mortality data is an important element in the fields of actuarial science, health, epidemiology and national planning. Mortality levels are generally regarded as indicators of a general welfare of a national population and its subgroups. It reflects the quality of life within quantity. Population forecasting is essential for all long term planning for the provision of services of a nation. Therefore developing a model for forecasting mortality rate will help a nation to develop its quality of life. The Lee and Carter (LC) stochastic mortality model was used in our study for fitting and forecasting the mortality rate of Norway which is considered as the country with the highest living standards based on the human development index. LC model was used since it is regarded as the golden model for mortality data due to the simplicity in parameter estimation. Moreover, it gives a good fit over a wide range of ages. The data set contained Norway mortality data from 1846 -2014. The Singular Value Decomposition (SVD) approach was used for estimating the parameters of LC model. Auto Regressive Integrated Moving Average (ARIMA) time series model was used for forecasting the mortality values.

In this study 97.5 % temporal variance of Norway mortality data could be explained by the 1st SVD component. The best fitting ARIMA model for Norway data was identified as ARIMA (3,2,1) which gave the lowest Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values. The general pattern of mortality showed higher child mortality for ages below 4 years and an accidental hump around ages 20 and nearly exponential increase after the age of 25. The sensitivity of mortality showed mortality decline at high rate for ages 20-25 years. Mortality index showed decreasing trend and two spikes due to World War I and World War II. The predicted Lee Carter model gives a good fit to Norway data over a wide range of ages but shows poor performance below age of 4 years and after age of 55 years. Therefore an improvement in the LC model is needed to obtain better predictions for these two age categories. This proposed model can be used to construct the life table for Norway and also for pension scheme planning and actuarial science applications. Furthermore, it can also be extended to handle mortality data of any other country.

A numerical study of pattern formation in Barrio-Varea-Aragon-Mani model

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The Barrio-Varea-Aragon-Mani (BVAM) model has been widely used to study the pattern formation on the skins of various fish species due to the fact that the patterns obtained from this model are very similar to the patterns on skin of various fish species. We performed a stability analysis to obtain the parameter relationship of the stable states of the model and to investigate the sensitivity of model parameters to the stability of the stripe pattern. Numerical simulations were performed to explore the different solution states categorized as swelled stripes with bends, defects and stripes with different orientation. The BVAM model was simulated in a MATLAB for a very long time ($\sim 10^6$) than in the literature in a 2D domain using Finite different methods and modified Euler method for time integration. The stable stripe pattern was obtained for the parameter values according to the conditions derived. This pattern becomes unstable for two system parameters: parameter that governs the changes in the reaction rates with respect to the concentrations and reaction rates that are counted by ratio between diffusion coefficients. We established a relation of the parameters with different solution states. Our extensive numerical work depicted that the stable state becomes unstable with stripes with bends followed by the stripes with bulges. When the parameter is further increased, the solution state further becomes unstable with different oriented stripes. We analyzed local wave vector of these solution states and when stripes are swelled forming bulges, the local wave number becomes very high and in the evolution, topological defects interact with the pattern and contribute to the subsequent formation of it. The critical wave number for the formation of the bulges is to be found as future work with the instability causing the defects.

Using data mining techniques to analyze of crime patterns in Sri Lanka

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Data mining has become one of the most popular technologies for statistical analysis and prediction for the future during last few decades. Its applications can vary from health to many important fields. Crime is one of the dangerous factors for any country. Moreover, data mining can be efficiently applied to those data in order to develop different strategies. The ultimate goal of crime analysis is to identify likely targets for police intervention and prevent crime or solve past crimes by making statistical predictions. Criminals follow common life patterns and most of the time, overlaps in those patterns indicate an increased likelihood of crime.

Our proposed solution consists of four major modules namely; 'Hotspot Analysis Module', 'Offender Profiling Module', 'Victim Profiling Module' and 'Suspect Predicting Module'. Data related to past crimes, which was used for the analysis was collected from Department of Police, Sri Lanka. Hotspot analysis module identifies crime hotspots considering geographical data of past crimes where victim profiling and suspect profiling modules identify the patterns or groups of victims who are most vulnerable and suspects who share same characteristics. The first three modules were developed based on simple k-means clustering algorithm whereas the fourth module is based on simple k-means clustering and j48 algorithm to generate the classifier model which can be used to predict the cluster of suspects of a crime.

The results of this analysis can be used by law enforcers to find general and specific crime trends, patterns, and series in an ongoing, timely manner in order to maximize the use of limited law enforcement resources, to have an objective means to access crime problems locally, regionally, nationally within and between law enforcement agencies, to be proactive in detecting and preventing crime, to meet the law enforcement needs of a changing society and to understand the criminal behaviors.

Factors affecting crimes in Sri Lanka

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Crimes have been disturbing threats to all the Sri Lankans all over the country. Crimes prevention should be achieved by altering the policies by government agencies. Finding key variables associated with crimes are very vital for policy makers. In this study, our main goal was to forecast of homicides, rapes and counterfeiting currency from 2013 to 2020 using auto regressive conditional Poisson (ACP) and auto regressive integrated moving average (ARIMA) models. All the predictions are made assuming that the prevailing conditions in the country affecting crime rates remain unchanged during the period. Moreover, multiple linear regression analysis and lasso regression were used to identify the key variables associated with crimes. Profiling of districts as safe or unsafe was performed based on overall Sri Lanka's total crime rate which is to compare with individual district's crime rates. Data were collected from Department of Police and Department of Census and Population. There are 14 safe and 11 unsafe districts in Sri Lanka. Besides it is found that total migrant population and percentage of urban population is positively correlated with total crime according to the partial correlation analysis. In time series analysis, ACP $(1, 1)$ models were selected for homicides, rapes and counterfeiting currency. In Multiple linear regression analysis, total migrant population, population density, percentage of Sinhala nationalities are significant variables for total crimes. Forecasts were made for Kurunegala and Anuradhapura districts and both forecasts were within 95% prediction intervals for total crimes. Total migrant population, Gini index, percentage of urban population, percentage of Sinhala nationalities are significant variables for homicides in multiple linear regression model. Forecasts were made for Colombo and Gampaha districts and both predictions were within 95% prediction interval for homicides. In lasso regression, total migrant population, population density, percentage of Sinhala nationalities are significant variables for total crimes. Furthermore, in the analysis of homicides, total migrant population, Gini index, population density and percentage of Sinhala nationalities are significant. Random K-nearest neighbor algorithm classified districts as safe and unsafe without use of the actual crimes and predicted with 84% of accuracy.

Developing a surrogate endpoint for AIDS clinical trials

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When it comes to the process of developing new treatments, the choice of an endpoint is crucial because this endpoint will be used to assess the effects of the treatments. However the most sensitive endpoint is difficult to use in a clinical trial because the measurement of the true endpoint can be costly and difficult to measure. Therefore the most feasible solution is to replace the true endpoint by another endpoint termed "surrogate endpoint" which can be measured earlier and more frequently.

Although there are some limitations, *CD4* cell count and viral loads are used in majority of AIDS clinical trials as surrogate endpoints. Therefore, the current study was intended on developing a surrogate endpoint for Acquired Immune Deficiency Syndrome (AIDS) based on a combination of variables. This study was based on a published dataset and consists of 16 variables measured on 1151 Human Immunodeficiency Virus (HIV) infected patients. Through the Log Rank test, variables *CD4*, *Karnofsky score* and age were identified as potential candidates for surrogate. The behaviors of those variables with respect to survival were further analyzed using Kaplan-Meier plots. Conventional statistics like sensitivity, specificity and attributable proportion were calculated to evaluate the suitability for surrogacy which suggests on its own *CD4* is the best to use as a surrogate. However a model with a combination of variables named score consisting of *CD4*, *Karnofsky score* and age yielded positive results in log rank test and conventional statistics was designed. Sensitivity of score was 0.78, specificity 0.62, attributable proportion 0.98. Score was also successful in identifying the difference between the two treatments. Validation of the score model using Prentice's criteria fulfilled all four criterions of Prentice suggesting that the model is accurate. The Prentice's criteria were also well validated for *CD4* yet, it is important to note that the newly developed surrogate endpoint score was better than *CD4* with respect to all four criteria. Sensitivity and the attributable proportion values of score were higher compared to *CD4*. Therefore, by considering all these facts, it can be concluded that the newly developed surrogate endpoint score is better than *CD4* to be used in AIDS clinical trials.

IT, Mathematics and Statistics

Predicting seed yield of *Ficus* fruits by fruit dimensions

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Ficus is one of the largest plant genus which has an ecological significance due to the presence of "keystone" species. Availability of its sole mutualistic wasp pollinator and the effect of non-pollinator wasps determine the availability of seeds in *Ficus* fruits to produce the next generation of each species. In most of the previous studies on seed yield of *Ficus* fruits, seeds have been counted manually, which is a time consuming, hectic process. Therefore, the main objective of this study is to introduce a model for predicting seed yield in two *Ficus* species. *Ficus racemosa* and *Ficus callosa* trees which are located in Kandy municipal area, Thumpane & University of Peradeniya were selected to obtain about 120 *Ficus* fruits from each species. Fruit length and two fruit diameters as diameter1 and diameter2 were measured. Additionally, pollinators & non-pollinators reared from each fruit were counted and recorded. Local polynomial regression and generalized additive models were used for constructing these models to predict the number of seeds per fruit. Correlation analysis was carried out to identify the relationship between number of pollinators and seed yield per fruit. Seed predicting models for *Ficus racemosa* and *Ficus callosa* were validated using Mean Squared Error (MSE) of testing samples and AIC, BIC values were used for selecting the best model.

Two models which were constructed for Kandy municipal and Thumpane were best described with least MSE of testing samples and moderately large R^2 values. Fruit length was taken as a single predictor for both models. It can be concluded that for predicting seed yield there is no need of measuring two diameters since the best model requires only fruit length. Merging observations of two species for single area gave a better result rather than predicting seed yield for separate species. This implies that type of species does not play an important role to predict seed yield of *Ficus callosa* and *Ficus racemosa* using generalized additive model with fruit length. This study reveals that when seed yield is less than 1000 it gives more accurate predictions with respect to higher seed yield. Poisson regression modeling gave a better result for modeling in *Ficus callosa* with min-max scaled variables with lowest MSE value of the testing sample. By using local polynomial regression curves, it was identified that biasedness and variance both can be optimized using optimal bandwidth and it gives freedom to the flow of data by keeping non-parametric qualities.

Applications of abstract group theory in the solvability of solitaire board games

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Peg solitaire, which is believed to be originated in England in late 1600, is a board game played by a single player. There are various shapes of boards while the cross-shaped board is the most common and popular. The solvability of the solitaire game depends on the particular shape of the board. In literature, a mathematical analysis of the solvability published in 1842 using parity arguments can be found. In 1998, Arie Bialostocki published a paper demonstrating an elegant way to analyze the solvability of the solitaire game of the cross-shaped board. In his paper, Bialostocki used the Klein four-group and its properties to analyze the possible solutions. This is perhaps the only instance the Klein four-group, an abstract group containing four elements, has been used to analyze the solvability of a popular board game. In this research, the techniques used by Bialostocki to analyze the solvability of the solitaire game were generalized to many other shapes of boards. Furthermore, the solvability conditions on some special shapes of boards were derived. A Single-Vacancy to Single-Survivor Problem (SVSSP) is defined as the possibility of winning a solitaire game starting with a full board game with a single-hole-vacancy (initial board configuration) and winning with a board configuration in which only one peg remains (winning board configuration). The solvability of this problem, together with the solvability of the complement problem (CP), which is a specific form of SVSSP in which the last peg resides at the initially vacant hole, were investigated using the techniques proposed by Bialostocki. Furthermore, the unsolvability of some solitaire games such as French solitaire and diamond solitaire were investigated using Bialostocki's techniques and by defining a 'resource count' which is also known as 'pagoda function'. In this research, many shapes of symmetric solitaire boards containing a central hole (except the triangular boards) were taken. Furthermore, the patterns, in terms of the number of holes of the board, for the solvability of the numerous shapes of solitaire boards were identified.

Evaluating the best treatment procedure for deep caries lesions in posterior permanent teeth

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In medical and social sciences, analysis of observer or inter rater agreement data often provides a useful means of assessing the reliability of a rating system. A rater can be a measurement method, an instrument, a medical device, a clinical observer, an assay or a technique or a technology. The response being measured may be a categorical variable such as success or failure of a medical treatment or it may be a continuous variable like blood pressure or heart rate. If raters agree well enough to be used interchangeably, then we may prefer the one that is cheaper, less invasive or easier to use. If raters do not agree sufficiently, then we select the best method using statistical techniques. The objective of this study was to evaluate the best treatment procedure for deep carious lesions in the posterior teeth. In practice, it is difficult to select the best treatment procedure by fitting models for all the treatments, as it is a time consuming task. Therefore, in this study, at the first stage we tested the agreement between treatment procedures using Kappa statistic and then selected the best procedure. If there is a good agreement between treatment methods, they can be used interchangeably. Otherwise we select the best treatment method using odds ratio and relative risk. Since there is no good agreement between treatment procedures, Chi squared test was used to check the significant difference between treatment procedures. At the second stage we modeled the data set corresponding to the best treatment method using Lasso Regression. Indirect pulp capping method with Calcium Hydroxide, injectable Glass Ionomer Cement (GIC) and light cured posterior composite (LCC) treatment was selected as the best treatment method for deep carious lesions in the posterior teeth. Moreover, a model for success or failure of this treatment method was fitted using Lasso Regression with three predictor variables, exposure time, exposure size and pulp conditions.

Application of Markov chain models for currency ranking among SAARC countries

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Although time series and regression models have been developed for currency exchange rate, there has been only little published work about the Markov Chain models for the currency exchange rate data. Many currency ranking methods are available. However, in the literature none of the ranking methods is based on Markov chain models. Markov chain based ranking scheme for SAARC currencies has been proposed in this work. Ten years exchange rate data which have been collected from first of January 2005 to first of January 2016 was used in this study.

There are seven SAARC countries; Sri Lanka, India, Pakistan, Bangladesh, Nepal, Bhutan and Maldives. The exchange rates of each of the above currencies were considered against strong currencies such as US Dollar, UK Pound, Chinese Yuan, Japanese Yen and Euro. Thus, we had five Markov chains for each country and hence there were 35 Markov Chains all together. Transition probabilities and steady state probabilities were obtained for the above 35 Markov Chain models. Frequency approach was used to obtain the transition probabilities. The state space of each Markov Chain is as follows: State S_1: (Loss), Current Month's average exchange rate is greater than the previous month's average exchange rate. State S_2: (Gain), Current Month's average exchange rate is less than or equal to the previous month's average exchange rate.

Steady state probability for the state S_2 (gain) can be used to rank the SAARC currencies. Moreover, we can rank the SAARC countries for exchange rate against each 5 currencies (US Dollar, UK Pound, Chinese Yuan, Japanese Yen and Euro). Thus, a specific SAARC country has 5 different positions in these five different rankings. Hence, an average of these ranks could be obtained for each of the SAARC country. This average rank was used to finally rank the SAARC currencies.

Maldives currency which obtained an average rank of 2.6 was obtained the first place in our ranking followed by Indian currency which obtained an average rank of 2.8. Sri Lanka with an average rank of 3.8 obtained the fourth place among SAARC countries.

Secure cognitive radio based multihomed and mobile femtocells

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The current 3GPP femtocell architecture is capable of reducing packet loss during handover by buffering and forwarding data. On the other hand, the proposed approach enables this by simultaneously maintaining multiple connections with the correspondent node. Similar to cellular networks, secure communication is an essence with femtocell networks. Currently, as specified by 3GPP, authentication of femtocells towards the core network is performed with Internet Key Exchange protocol version 2 (IKEv2). According to 3GPP standards, secure connectivity between the femtocell and core network is IPSec based. To realize the proposed mobile femtocell scenario, femtocell operating system must recover the connectivity to the core network when it moves from one location to the other. It should be noted here, that these nodes could be located in open environments like buses, metros, flights, etc. Therefore, in one hand, frequently changing connectivity and repeating authentication procedures could be a security vulnerability since the knowledge about IP and network security is widely adopted by the society. On the other hand, frequently changing mobility tear-down already established associations in all layers of the network stack. According to our studies, an identity/locator separation is a potential solution to overcome this problem.

In this work, a secure backhauling and authentication mechanism for cognitive radio based femtocells were proposed. The current 3GPP femtocell architecture is capable of reducing packet loss during handover by buffering and forwarding data. Instead, multihoming capabilities on femtocells to enhance seamless mobility and availability were introduced. With mobility, throughput was hindered by authentication and connection establishment phase which is performed in order to negotiate keying materials and to establish a new secure association between the roaming femtocell and the secure gateway (SeGW). A novel mobility management approach for roaming cognitive radio based femtocells was presented in this study and further, their impact on throughput, especially in file transfer were investigated. This scenario was evaluated by mean of simulations. Cognitive radio based femtocells with seamless mobility were presented in results. This solution has a better throughput improvement compared to 3GPP femtocells for delivering small and medium size file contents.

How to pump a swing?

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Modeling the pumping of a swing is a classical mathematical problem that appeals to the Newton's second law of motion. In the literature, pumping of a swing has been modeled in numerous ways. Elementary models assume that the rider of the swing is a point of mass whereas some advanced models consider the angular momentum of the rider in the course of pumping and assume that the rider's body-weight distribution is uniform from head to heels. Even if the existing models are adequate to explain the dynamical behavior of pumping a swing, there are various factors that need to be taken into consideration for precise modeling of the subtle movements of the rider during the course of pumping. For example, the person may rotate his arms, legs and his head during the upward and downward movements of the swing, especially at the highest and lowest positions of the swing. Furthermore, the weights of different parts of the body are different and their positioning during the motion of the swing may result in introducing new parameters to the model. In the model we proposed, the body-weight distribution of the person and the changes of angles of various parts of the body, especially legs and the upper part of the body above the waist, were taken into consideration. Moreover, the basic technique we used in establishing the dynamical system was considering the changes of the center of gravity of the rider at various stages of the motion of the swing. Numerical simulations using Matlab are carried out to draw phase trajectory diagrams and other important graphs of the motion of the swing. Many graphs are drawn changing some of the parameters and comparisons with the existing models were used to validate the new model. Moreover, the video images of actual pumping of a rider were used to investigate the accuracy of the model. The numerical simulations and comparisons revealed that the proposed model gives better approximations to the actual pumping of a swing.

Optimal solution to timetable scheduling problem using 0-1 integer programming: a case study of a school in Sri Lanka

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In many real world scenarios scheduling is applied to perform a particular task efficiently while overcoming the limitations to perform that task. Educational field is an area where scheduling is essential. In this article a time table schedule is implemented to a particular section in a school which will arrange a sequence of classes between students and teachers.

The Technology subject stream was introduced to the education system in Sri Lanka in 2013. Due to the lack of resources most of the schools which started the new subject stream face difficulties in implementing a proper time table schedule. A major school in the Central province in Sri Lanka was used as a case study.

The main objective of the study is to maximally assign teachers to the classes based on their precedence levels and availability. An integer programming model was implemented in order to achieve the above mentioned objective. A set of binary (0 or 1) integer decision variables were defined in order to check whether a teacher is allocated to a class in a given time slot or not.

The set of constraints that should be satisfied in order to achieve the optimal allocation of teachers are, each subject should be taught exactly 1 time slot in a given day (a given working day consists of 5 time slots), each subject should cover exactly 5 time slots per week, the school has limited number of class rooms (6 class rooms) to conduct several subjects at the same time, some teachers are not available for the technological section in certain time slots, a teacher cannot teach two classes at the same time.

The optimal feasible allocation of teachers to the classes while satisfying the set of constraints can be obtained using Microsoft Excel package. Then with the use of the obtained results, a time table schedule can be implemented for the section.

The existing time table schedule for the section was obtained with the past experience and inquiries made by both teachers and students. Thus an optimum, feasible allocation of teachers was obtained after a series of trials. But with the use of the implemented integer programming model an accurate schedule can be implemented easily. By making few changes to the model, it can be used to construct time table schedules for the other sections of the school as well.

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Interference mitigation for co-working wireless LANs

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Wi-Fi, Bluetooth and many other devices operate at the same ISM band of 2.4 GHz. The demand for those devices has increased exponentially. As a result, the number of co-located devices has increased and is a cause for interference issues. This has downgraded the network performance, resulting in low downlink and uplink speeds. This work investigated the issues regarding interference and also developed a mathematical model to predict the power level of an indoor environment. Finding the optimal location for a newly installed router where there are many other routers operating nearby, was the objective of the mathematical model. This work also discussed an implementation of router antenna tilting mechanism to mitigate the interference in an indoor environment.

An indoor environment without any effect of interference was considered as the test bed. Power measurements were obtained using InSSIDer4TM software. A ZTETM router was considered as the Access Point. A grid of 80 points of the test bed was constructed and measurements were taken at grid points by moving the laptop to those locations. The procedure was repeated for five scenarios of the location of the Access Point.

Simplified path loss model was considered as the mathematical model and its parameters were found using linear regression. This model was then used to predict the power variation inside an indoor area. The hardware implementation made sure that the receiver will have a better line of sight path. The router was rotated in steps of 10° until 60° and the variation of power level received was observed. It was noted that the tilting of router had some considerable effects on the received power level and can be used to control the interference effect.

Implementing a client-server setting to prevent the browser reconnaissance and exfiltration via adaptive compression of hypertext attacks

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The Browser Reconnaissance and Exfiltration via Adaptive Compression of Hypertext (BREACH) attack is a compression-based side-channel attack, which targets sensitive pieces of data compressed-then-encrypted in the HTTP responses. The BREACH attack was firstly demonstrated in Black Hat Europe 2013.

The HTTP compression is the process of compressing the content in the HTTP responses from the server-side, before sending them to the client. The HTTP compression is normally performed through the DEFLATE algorithm, which is a combination of the LZ77 algorithm and Huffman coding.

The main reason that makes the BREACH attack possible is that the adaptive compression-dictionary used in the DEFLATE algorithm, which enables the algorithm to develop a compression-dictionary based on the content to be compressed. After compressing with the DEFLATE algorithm, even when encrypted, the length of the compressed data is still visible. In the BREACH attack, the attacker injects his guesses of the secrets into the HTTP response bodies. Due to the adaptive compression-dictionary, if the guessed bytes match with the actual secrets, responses would be highly compressed and hence the output length differs. As the length of the responses would reveal information on how much overlap has happened, the attacker can measure how much of the attacker-injected bytes are contained in the sensitive pieces of data in the system.

The BREACH attack can be mitigated by using a non-adaptive fixed dictionary for compression, because the dictionary is independent from the inputs, and hence the attacker-injected guesses cannot affect the dictionary; the data will be compressed if they match with the dictionary entries, otherwise not. This idea was first proposed with security proofs in a reasonable model in Financial Cryptography and Data Security 2015.

In this research we implemented and deployed a non-adaptive fixed-dictionary compression algorithm into the real-world client-server setting, and facilitate a realistic mechanism to prevent the BREACH attack. Further, we verified the correctness of data recovery in the client-side.

Developing a model to show the potential impact of weather patterns on dengue disease and vector densities

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The emergence and re-emergence of dengue epidemics have suggested the influence of weather patterns on dengue vector density (*Aedes aegypti and Aedes albopictus)* and epidemiology of dengue disease. Understanding of weather patterns on dengue vector densities, therefore, is crucial in optimizing vector control strategies. The objective of the present study was to understand the relationship between dengue vector density and the weather variability to develop a model to show the association between weather variability, vector density and dengue cases.

Data collection was done monthly in Kaduwela MOH division from 2009 to 2011. The vector densities (Breteau index) were determined by larval surveys. The data set contained 36 observations with 5 variables (monthly: rainfall, humidity, temperature and number of rainy days). There was a significant correlation between number of rainy days during a month with rainfall (r=0.685), humidity (r=0.655) and vector density (r=0.655) as well as between monthly rainfall and humidity (r=0.737). The monthly average temperature, however, did not show a significant correlation with other variables.

Random sample of 30 observations were selected to fit a multiple linear regression model to predict the vector densities. The model with all predictor variables indicated the existence of multicollinearity. Hence, the stepwise regression method was used to find the best model. Simple linear regression model with the predictor: number of rainy days during month, was selected as the best model (R^2 36.56%). After transform response variable (vector density) with Box-cox transformation, the resulting model showed a significant improvement in R^2 (45.63%). This model was used to predict the vector densities of left-out six observations and the actual values were well within the 95% prediction intervals. The validation of the model did not indicate any violation of model assumptions. The results of this study, therefore, suggest that unobservable factors other than observed variables may account the total variability of monthly vector density. Future studies will focus on developing predictive models to forecast weather induced dengue epidemics in Sri Lanka.

Implementing a leakage-resilient storage scheme and a refreshing protocol to prevent continuous leakage attacks

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Although the cryptographic schemes are designed in a way that they are hard to break computationally, leaking information from their implementations (timing, EM radiation, power traces) may give sufficient power to the attacker to break the system by fully or partially recovering the secret parameters such as secret keys. Such attacks are known as side-channel attacks. The secret data can leak to the attacker while they are stored in the memory or involved in computations. The leakage-resilient cryptography aims to design proven-secure cryptographic schemes against side-channel attacks.

If the secret value has less number of bytes, the attacker can obtain bounded amount of bytes from a side-channel attack, and get rest of the bytes by brute-forcing. In this work, we implement a leakage-resilient (LR) storage scheme and its refreshing protocol. The LR storage scheme can securely store a secret in the memory against side-channel attacks (bounded memory leakage attacks), and the refreshing protocol can protect the secret from repeatedly occurring side-channel attacks (continuous leakage attacks). Above LR storage scheme and protocol work as follows: The LR storage scheme expands the number of bytes of the secret into very large amount of bytes, without damaging the actual value. Then the attacker has to steal a lot of bytes to recover the secret. Usually, such a large amount of bytes cannot be obtained by side-channel attacks. If the attacker obtains continuous leakage, then he has a chance of revealing a large amount of bytes of the secret. Therefore, the refreshing protocol continuously refreshes the expanded value, without damaging the actual secret value.

In order to achieve high security, we have to sacrifice the efficiency by introducing additional computations in expanding the secret value and refreshing. As a solution for that, we use the GPU for those computations by implementing them in CUDA. As a real-world application of this implementation we can integrate the LR storage scheme and the refreshing protocol with a Diffie-Hellman-based key exchange protocol and RSA algorithm, to implement them in the leakage-resilient manner.

A theoretical analysis of securing LTE backhaul network using host identity protocol

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Long Term Evolution (LTE) is expected to provide end-to-end security with many other promising features. However, with unencrypted transmission in the backhaul network (network segment from evolved node B (eNB/eNodeB) to core network), end-to-end security guarantee is violated. Unlike in legacy standards, security standards for LTE do not specify backhaul security implementation and expects service providers to adapt backhaul security. Third Generation Partnership Project (3GPP) has recommended but not mandated implementing Internet Protocol Security (IPsec) with Internet Key Exchange v2 (IKEv2). Nevertheless, most vendors do not implement IPsec for on various reasons like implementation and maintenance cost, overhead, and lack of experience in security implementation.

To assure end-to-end security, backhaul needs to be protected. In order to implement backhaul security, we proposed a new backhaul architecture using Host Identity Protocol (HIP) (HIP-LTE backhaul). HIP is capable of authenticating end nodes in the base exchange process and transmit Internet Protocol (IP) packets using Encapsulated Security Payload (ESP) transport mode by providing encryption and adding integrity protection as ESP – Bounded End to End Transmission (ESP-BEET) mode packets. A Security Gateway (SeGW) is used at the core network and backhaul network interface to work as one end node to reduce overload in HIP processing at core network nodes. eNBs and SeGW are the only nodes needed to implement HIP.

We evaluated security of HIP-LTE backhaul network using analytical model based on ISO security architecture. In the study, we identified security mechanisms available and derived security services in HIP-LTE backhaul. Then we performed a compliance evaluation with 3GPP security requirements for LTE backhaul and found that all the security requirements are fulfilled by new architecture with additional security measures as resilience to DoS, MitM, Replay and flooding attacks. Thus HIP-LTE backhaul is capable of providing security in the backhaul segment without direct IPsec implementation. This reduces the operator effort to implement security in backhaul with less cost.

HIP-LTE backhaul network can be used as an alternative in securing LTE backhaul networks.

Opinion mining on various aspects of health through social media analytics using collective sentiment feature analysis and deep neural networks

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Social media such as Twitter and Facebook provide a perfect platform to create awareness in the areas such as health, current affairs, etc., because of their dynamic behavior. In particular, they encourage users to post ideas, views and random details of their everyday life. Most of those messages (i.e., wall posts and tweets) contain a less informational value, but a collection of messages can generate important knowledge which provides valuable insight on various aspects of life. According to recent studies, even in developed countries, the 'health literacy' is found to be considerably low. Typically, people have their own views and experiences regarding certain diseases and treatments. For instance, in the social media, there can be tweets and wall posts on numerous real-life experiences about treatments for some diseases such as common flu. In fact, those views show the real picture about the effectiveness of those treatments. Hence, comprehensive analysis of large volume of such social media content may lead to interesting conclusions.

One of the key steps in making health awareness using social media analytics is the sentiment analysis of health related messages. Sentiment is the attitude, opinion or feeling toward something which indicates the contextual polarity. This study presented a general framework for opinion mining on various aspects of health, through the analysis of typical public reactions towards health and well-being in Twitter media. The proposed framework was developed based on "collective sentiment feature analysis" and deep neural networks. This novel collective sentiment feature analysis method aims to map a given tweet to a feature space that captures the sentiment of the tweet as a whole taking the relationship of the keywords in the sentence into consideration. First, the tweets mentioning about selected health issues were collected, preprocessed and labeled. Each sentence was represented by a "collective sentiment feature vector" that is learned using a classification algorithm. In order to make a better generalization in the polarity classification of tweets, a state-of-the-art deep neural network is trained. The main advantage of the proposed method over the existing methods is its ability to generalize even large data sets as a result of the trained deep neural network. The performance of the proposed framework was evaluated by conducting an experimental study on twitter posts extracted using "Tweepy" a python wrapper for Twitter REST API. Three data sets containing tweets about dengue disease, H1N1 influenza and other general health topics were used for the evaluation. A promising average F1-score value of 0.73 was obtained during testing.

Texture based image recognition using deep neural networks

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Texture is a coherent property which belongs to a surface of an object or a region. It carries important information on the structural arrangements and distributions of primitive patterns in the formulation of surface appearance. Texture analysis is one of the key aspects of image recognition and image processing. In human perception of natural scenes, image texture is efficiently processed to give an accurate understanding of the image regions. However, optimal texture feature extraction to discriminate many texture classes artificially is a challenging problem in computer vision. The choice of traditional texture features for texture classification is subjective and highly application dependent with lower generalization to other image textures. Therefore, here we suggested a more generalized Deep Neural Networks (DNN) based approach which can address the optimal texture feature extraction problem. Instead of heuristically selecting an existing texture feature extraction method or a feature selection process, here the hidden layers inside the deep neural network architecture automatically perform those functions without user intervention to give the best texture discriminating performances.

Two commonly used image texture datasets are employed for classification experiments, namely Brodatz and CURet. From each dataset, a total number of images of 5000 and 620 from 10 classes were employed respectively. These texture images include rotation and scale variations in the texture. To acquire more descriptive features, Unwrapped Image Vector (UIV) of the input texture image was considered first. The proposed DNN which comprises several hidden layers can automatically extract the best texture features spanning from micro to macro scale, without losing useful information which usually happens in the traditional subjective texture feature extraction. Furthermore, intensity histogram (IH) and reduced image vectors using Principal Component Analysis (PCA) are also incorporated by the proposed DNN in order to increase the performance. A regularized cost function for DNN was used to avoid over fitting. The experiments were performed on a laptop with Intel dual core 2.20 GHz processors and 4GB RAM with MatLab 2015 environment operating on a 64bit Windows operating system.

DNN achieves more superior classification results than the Artificial Neural Network (ANN) which generally consists of one hidden layer. Moreover, the best classification accuracies are acquired when PCA is used. The Dimension reduction by PCA yields a smaller network with less number of hidden units which performs efficiently due to reduced computational power. The results on Brodatz dataset showed that with a DNN of two hidden layers, an average accuracy of $98.70\pm0.97\%$ could be achieved while the ANN only gives $87.22\pm8.02\%$ for the same dataset. The classification results on CURet dataset showed that DNN obtains an average accuracy of $97.60\pm3.51\%$ while the ANN only achieves $77.41\pm3.24\%$ test accuracy. Therefore, using DNN, traditional subjective feature extraction and selection can be avoided and better classification accuracies can be obtained in a direct automated manner.

Study of awareness of Computer Vision Syndrome, its prevention and the prevalence of vision related problems of professional computer users

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The Computer Vision Syndrome (CVS) is a collection of symptoms (Headache, Eye strain, Dry eye, Photophobia, Blurred vision and Diplopia) that are caused by prolong computer usage. CVS has an impact on the physical well-being and the productivity of computer users. The CVS remains as an underestimated and poorly understood issue in the world. Therefore, this study was done to investigate associations among awareness of CVS and its prevention and also the prevalence of vision related problems of professional computer users caused by computer usage.

There were 72 identified software companies in Colombo (sampling frame) and no significant differences of computer users among companies. Six companies were randomly selected and each user was included in the sample. This sampling scheme is defined as a one-stage cluster sampling. The sample consists of 106 professional computer users. The data were collected by self-administered questionnaire. Data analyses were descriptive statistical analysis, test for associations using chi-squared tests and correlation analysis.

The results revealed that awareness of CVS was relatively low (34%). The awareness was not significantly associated with gender (p=0.47) but significantly associated with educational levels of computer science (p=0.01). Females were more aware about CVS and its prevention. The usage of safety precaution were significantly greater in females than males. The computer users having MSc were more awareness of CVS and safety precautions than those having Diplomas or BSc. The most of professionals who have MSc knew about safety precautions, their usage of safety precautions and the awareness of ergonomic modifications were relatively low compared to Diplomas and BSc. The eye fatigue was the most common vision problem (45%). It has strong significant (p<0.001) positive correlation (r=0.9908) with the number of hours of using computer for a day. The percentage of eye fatigue increased with the number of hours of using computer for a day. The most effective safety precaution is work breaks. The majority (67%) of sample used work breaks, however, only 20% of the sample used proper work breaks. This study was limited to Colombo district, however, there was no evidence that CVS is related to geographical location.

Comparative study on different model reduction techniques in MIMO systems

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Large physical systems usually result in complex high-order dynamic models. Numerical simulations of dynamical systems are routinely used for studying complex physical phenomena. However, for very high-order systems the storage and computational requirements of such simulations may increase to unmanageable levels. One option is to use parallel computing to reduce the computational burden, which is expensive and also depends on the parallelizability of the simulations. Additionally, almost all the modern control design philosophies such as LQG, H_2 and H_∞ result in controllers of the same size as that of the plant. Due to these reasons the reduction of the model is important. In this process it is essential to derive the reduced model so as to capture the important properties of the original system. Eliminating certain states while having a reasonable representation of the original system is known as model reduction. The central idea of the model reduction is to find a reduced order model G_r of order r of the original system G_n of order n ($r \ll n$) such that the infinity norm of their difference $\|G_n(j\omega) - G_r(j\omega)\|_\infty$ is sufficiently small.

In this paper, three different model reduction methods were compared. Methods of interest, *Direct Truncation* (DT), *Balanced Truncation* (BT), and *Moment Matching* applied to a MIMO system. Using the above mentioned approaches the closed-loop system was reduced to a 6-states model such that it retained the essential properties of the original system. From the frequency response and the time-domain responses, it was observed that the BT was able to capture the critical modes of the system better than the moment matching through *Arnoldi* decomposition. Since the BT approach uses the *Lyapunov equations* for obtaining the controllability and observability gramians, it is limited to a moderate order system. As the dimension increases the BT breaks downs. In such conditions the moment matching approach is preferred over the BT method. The future work will be on finding the most appropriate moment matching technique when very large systems with dense state matrix are involved and the BT fails to solve the Lyapunov equations.

Co-expression analysis of DREB family transcription factors in rice

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In the course of evolution, plants have evolved specific defense mechanisms by expressing variety of genes to adapt and survive stressful events. There are many signaling networks in plants involved in abiotic and biotic responses. Moreover, these signaling pathways stimulate expression of specific sub-sets of genes that activate the overall stress defense responses. Among them, Dehydration Responsive Element-Binding (DREB) proteins are important Transcription Factor Family (TFF) which plays a critical role in developmental and abiotic stress (drought and temperature) mediated gene expression networks in plants.

This study investigated co-expression analysis of DREB family transcription factors in rice and the study comprised 14 genes which belong to DREB family in rice. The main objective of this study was to discover the functional roles of DREB family members using the co-expression genes. In addition, GC content of each gene in *DREB1* and *DREB2* family members were calculated. Furthermore, 27, 201 genes for each DREB TF family genes in rice were analyzed to investigate putative functions of those genes in both biotic and abiotic stresses by calculating weighed Pearson correlation coefficient (WPCC) and mutual rank (MR). Then genes with MR<10 were selected and GO enrichment analysis was carried out to identify the significant functions in *DREB* genes. Interestingly, co-expressed genes of both DREB1and DREB2 families were shown to be enriched with GO terms related to stress related functions such as protein ubiquitination, regulation of transcription, response to abscisic acid stimulus, response to deep water, abscisic acid catabolic process. The findings of this study will provide a platform for future studies on uncovering functional roles of *DREB* family genes in rice.

A robust technique to transform time series with missing data into a zero mean series

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In the process of knowledge mining, feature scaling plays a crucial role. For feature scaling, there are two widely used methods in many machine learning algorithms, namely, mean normalization and standardization. In both these methods, mean is zero and consider only the dependent variable (y); no involvement of independent variable (x). Thus, regardless of the original regression, those approaches treat all the data as $y = c$ series. However, when some data points are missing or removed (as outliers), the said approaches destroy the original regression. In this research, a novel standardization method to standardize data based on linear regression ($y = mx + c$) was introduced. The proposed transformation was given by $y_{new} = y^T - x \times \overline{y^T}/\overline{x^T} + c$, where $y^T = y - y_r$, $x^T = x - x_r$, (x_r, y_r) is any selected reference point, and c is any constant. The speciality of the proposed method is that the transformation used both independent and dependent variables. Thus, no influences form missing or removed data. When there were no noise or outliers, the new method transformed data into a $y = c$ series even with multiple missing values. When $c = 0$, results showed that the transformation produces a zero mean series from any data set even with noise, outliers and missing values.

Abstract No: 560 (Poster)   *IT, Mathematics and Statistics*

A stochastic approach to model traffic in a road network

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Traffic congestion in the urban areas has become an unremitting problem faced by city planners. This phenomenon could result in adverse situations such as excessive fuel consumption, escalation in vehicle operating costs, time waste etc. Thus, it emphasizes the need for an efficient solution for the traffic scenario. Traffic scenarios have been extensively studied under diverse methodologies to predict when and where the traffic would appear. Stochastic methods such as Marko chains and Monte Carlo simulation produced fruitful results and are proven to be highly effective in terms of predictions along a segment of highway, freeway etc. However, a major drawback of these methods is the lack of feasibility when applied to the road networks in its entirety, due to the high complexity. This study attempted to introduce a new concept based on Markov models to overcome these drawbacks by mainly focusing on striking a balance between the route capacity and total surface area of vehicles of different vehicle types (motorcycles, cars, three-wheelers, buses and heavy vehicles). A road system with multiple junctions and lanes was considered and represented in matrix form. A separate matrix was assigned to each vehicle type to record the counts of each vehicle type that enters a road segment within short intervals of time. Thereafter, the total surface area of vehicles occupying each road segment was expressed as a proportion of road capacity. By repeating these steps several times on a given day, the traffic state transition for the given segment was estimated. Given the state of traffic for a road segment, these transition matrices can be used to identify the converging traffic state in the future. A road network with 7 junctions having 10 connecting two-way road segments was considered for the simulation study. For each vehicle type, the flow of traffic was assumed to follow a Poisson distribution with varying rates. Results showed that the proposed method worked as expected for different initial conditions of the traffic flow. Future studies would extend the proposed method by considering other criteria such as vehicles parked on either sides of the roadway, vehicle speed and weather conditions.

Novel solution for real time mobile click fraud detection

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Significant increase of mobile Internet browsing in recent years has led to an increase in the popularity of advertising in mobile devices. With smart phones having wireless connectivity and GPS location capability, mobile advertising ad platform can make personalized and localized advertising, which is the main difference when compared with traditional TV advertising. Mobile ad is a key pillar to the mobile app ecosystem. Unfortunately, this huge-revenue ecosystem is severely thwarted by ad fraud due to large sum of money available in this market. The main categories of ad fraud are bot-driven frauds and placement frauds.

Though click frauds have been relatively well-studied in desktop environments, there are few research studies on mobile click frauds. Existing approaches mainly focus on offline testing to detect click frauds. In this paper we proposed Real Time Mobile Ad Investigator (RTMAI) to investigate incoming traffic to a particular web site through mobile devices. In RTMAI we provided three layers to collect (Front-end data collection layer), process (Back-end data processing layer) and to analyze (Decision making layer) incoming traffic to the target web site.

Whether a click is fraudulent or not is decided at the decision making layer. RTMAI uses two systems called Horizontal Analysis Sub System (HASS) and Vertical Analysis Sub System (VASS) to make decisions.

In the HASS we analyzed individual events. For an example there should not be any touch events if the device is a desktop. In VASS, RTMAI analyses events over a period of time to see if there are abnormalities. For example, mobile device height should be the same for the entire user session.

RTMAI assigns weights for each attribute value pair in the HASS and VASS. A fraudulent score for a click is then calculated as a function of these scores in real time.

Current results showed that RTMAI is capable of identifying majority of automated user events either from mobile devices or desktop devices and almost all of emulator based user events with higher accuracy. The system provided a better solution for identifying bot generated events over that of real user events.

Abstract No: 13   *Natural Sciences*

Synthesis and characterization of Copper(ll) and Cadmium(ll) Complexes of hydroxamate derivatives

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Hydroxamic acids are N-hydroxy amides, which are derivatives of hydroxylamine and carboxylic acids. Hydroxamic acids are naturally occurring or synthetic weak organic acids. They contain the oxime (–N–OH) and the carbonyl (C=O) groups. Two possible hydroxamic acid tautomers exist, one (the keto isomer) is predominant under acidic conditions, and the other enol form is stable in alkaline conditions. The presence of (E) and (Z) isomers of hydroxamic acid anions extend the structural diversity. Hydroxamic acids are powerful metal ion chelating agents. Hydroxamic acids are an important class of bioactive compounds with wide uses as anti-bacterial or anti-inflammatory agents and a key component of many natural products, mainly siderophores in lower organisms. It is used as inhibitors of hypertension, tumor growth, inflammation, infectious agents, asthma, arthritis, Alzheimer's diseases and more.

In this study, Copper (ll) (SRC1 and SRC3) and Cadmium (ll) (SRC2 and SRC4) complexes were synthesized from potassium hydroxamate derivative ligands and they were characterized by FTIR and Electronic spectra as well as by melting points and conductivity measurements .The electronic spectral study and the melting point analyses revealed that the ligands were coordinated to the metal centre. FTIR and conductivity analyses confirm the coordination of hydroxamate ions as O, O-bidentate mode (via the hydroxyl oxygen and the carbonyl oxygen atoms of the ligands) to the metal centre. Based on the experimental evidence a possible structure is also proposed.

Cosmological model to evaluate the present radius and density of the oscillating universe

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In 1997 it was shown that that the Universe is expanding with acceleration. Many models have been employed to explain this incident. Use of variable cosmological parameter was proposed by Hemantha and de Silva (2003) (2004). They wrote modified field equations in the form

$$R^{\mu\nu} - \frac{1}{2}\bar{R}g^{\mu\nu} = \kappa T^{\mu\nu} - \Lambda g^{\mu\nu}, \text{ where } \boxed{FSI} = \frac{-8,G}{c^2}$$

In this study a solution $R = l + d(1 - cos^3\alpha t)$ for the above equations was obtained. This model represents the Universe with deceleration, acceleration and again deceleration. The unknowns $, d, \alpha$ can be found under the following specified boundary conditions. According to the Big Bang theory, the radius of the Universe is zero at the beginning of the universe (this is the first boundary condition) so it can be chosen as $l = 0$.

In the literature it is found that the onset of acceleration took place at red shift is in between $1.2 - 1.6$. It was taken 1.3 for redshift in this study and the age of the Universe was considered as 13.7 billion years (this is the second boundary condition) and it gives $1.3 = (1 - cos^3\alpha t)$ and calculate $\alpha = 1.7348 \times 10^{-18} \sim \supset /\dot{s}^{-1}$.

It was considered the ratio $\frac{\Lambda^/}{\rho} = \frac{7}{3}$ $(\Lambda^/ = \frac{\Lambda c^2}{8\pi G}\Lambda$ is the cosmological constant) for evaluating d. It was obtained $^= = 1.1829 \times 10^{28} \, cm$.

Finally, the radius of the Universe was obtained and the density of the Universe and the behavior of the radius of the Universe against the cosmic time was discussed. According to the results, the radius of the Universe at present epoch $R = 1.5376 \times 10^{28} \, cm$ and the Density of the Universe at present epoch $\rho = 1.5587 \times 10^{-29} \, gcm^{-3}$.

Survival and development of *Menochilus sexmaculatus* (Fabricius) (Coleoptera: Coccinellidae) larvae on natural and formulated diets: an attempt for mass rearing

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Menochilus sexmaculatus (Fabricius) is an effective bio-control agent and requires mass rearing them to use in augmentative release. Rearing on natural prey demands the maintenance of host plants and aphid cultures. Therefore, it is necessary to examine the possibility of using artificial diets. The objective of this study was to examine the possible replacement of natural diet of aphids by alternative diet sources.

Larvae of *M. sexmaculatus* were provided with seven different diets: D1egg yolk, D2 boiled chicken liver (10 g) in 60 ^{0}C, 100 ml hot water for 10 minutes and ground by using the motor and pestle, D3 boiled chicken liver (10 g) in 60 ^{0}C, 100 ml hot water for 10 minutes and ground by using the motor and pestle while adding 60 adult aphids, D4 boiled chicken liver (10 g) in 60 ^{0}C, 100 ml hot water for 10 minutes and grind by using the motor and pestle adding legume juice, D5 aphids, D6 ground house fly maggots and D7 fish meal powder. The survival rates and development durations of larvae were recorded. Each treatment was replicated 15 times. The data were analyzed using One way ANOVA followed by LSD mean separation using Minitab statistical software.

The survival percentage of the larvae varied significantly among the treatments ($P<0.05$). The highest survival percentage (95 %) was recorded when the larvae were fed only on aphids while, the lowest was recorded when the larvae reared only on egg yolk and fish meal powder. The survival percentage of L3 and L4 stages was significantly varied, when they were fed on chicken liver. The total larval duration was also significantly varied with different diet regimes ($P<0.05$). The fastest growth rate was recorded when all larval instars were fed exclusively on aphids. The longest duration was taken when L1 fed on aphids and other three instars fed on the chicken liver. This study revealed that the chicken liver can be used for mass rearing at the larval stages of L2, L3 and L4 with a compromise of survival rate.

Insecticide-induced feminization of frogs: effect of exposure of common hourglass tree frog to three insecticides

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Many pesticides are known endocrine disruptors and act as gonadotoxins especially in males with demasculinization and feminization effects. Here we investigated the effects of three insecticides: Profenofos, Diazinon and Carbosulfan on the development of gonads of males and females of common hourglass tree frog, *Polypedates cruciger* under laboratory conditions. Egg masses of *P. cruciger* were collected from natural habitats and brought to the laboratory. Upon hatching, 20 tadpoles at Gosner stage 25 were placed in glass tanks and were exposed to an ecologically relevant concentration series of the three insecticides. Each chemical trial had four treatments and dechlorinated tap water as a control. The survival was recorded weekly and the tadpoles were raised until metamorphosis (Gosner stage 31). The metamorphs that survived were reared until Gosner stage 42, euthanized using MS-222, fixed in Bouin's and the gonads were sectioned, slide mounted and stained with hematoxylin and eosin. Survival of tadpoles in all insecticide-exposed trials was significantly lower compared to the control (Chi square test; $p < 0.001$). Among the three insecticides, Carbosulfan exposed frogs had the highest reduction in survival in all the concentrations. Gonads of a total of 62 males and 43 females were sectioned. None of the females or males in the control group and the lowest concentration of the Diazinon (0.375 ppb) exposed group had any abnormalities in their gonads. However, the males exposed to different concentrations of the three chemicals had developed testicular oocytes at varying percentages. The number of oocytes per testis varied with the insecticide and the concentration. Among the three insecticides, Carbosulfan had a more profound feminization effect on male frogs than other chemicals. Feminization of male gonads is the development of oocytes in the testes or complete ovarian differentiation of genetic males leading to decreases in the frequency of morphologic males.

Synthesis of zirconia nanoparticles from
Sri Lankan zircon sand

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Zirconia (ZrO_2) nanoparticles are very important for the production of a wide-range of technological devices and products such as solid oxide fuel cells, oxygen sensors, abrasion-resistant gloves, heating elements, high-temperature refractory materials and ceramic prostheses. The major source of zirconia is zircon ($ZrSiO_4$) sand, a silicate mineral of zirconium. There is a vast amount of zircon sand available in coastal areas of Sri Lanka. The extraction process of zirconia from Sri Lankan zircon sand had previously been studied at the Department of Physics, University of Peradeniya by Karunaratne et.al., 1993. The present study focuses on modification of previous extraction process to synthesize nanometer sized zirconia from Sri Lankan zircon sand.

In this study, zircon sand was fused with sodium hydroxide and the fused mass was dissolved in distilled water. The obtained residue was then dissolved in concentrated hydrochloric acid to produce zirconium oxychloride octahydrate ($ZrOCl_2.8H_2O$). Diluted sodium hydroxide solution was added dropwise to the diluted zirconium oxychloride octahydrate solution and different colloid stabilization methods such as use of surfactants (Triton X-100, cetyltrimethylammonium chloride, sodium dodecyl sulfate) and *in-situ* polymerization of methyl methacrylate (MMA) were used to inhibit particle agglomeration. Precipitated hydroxide of zirconium was separated by centrifugation and decomposed at 650°C to obtain nanometer sized zirconia. X-ray diffraction and x-ray fluorescence results confirm that to the final product comprises ZrO_2. The dynamic light scattering particle size analysis (DLSPSA) and scanning electron microscopy (SEM) reveal that the ZrO_2 product is in nanometer scale.

The smallest average particle size obtained for the zirconia nanoparticles was about 40 nm with the use of *in-situ* polymerization of MMA. Further, these nanoparticles appeared to be spherical in SEM images and approximately monodispersed according to DLSPSA. The products prepared using surfactants of SDS, CTAC and Triton x-100 were moderately polydispersed zirconia particles with the average particle sizes of 311 nm, 473 nm, and 498 nm respectively. The yield of the extraction process was about 83 % at a purity of 97 % zirconia. The major impurity in the final product was found to be 3 % of hafnia (HfO_2), which is present in zircon sand as an impurity. The separation of hafnia is not required for most of the practical applications of zirconia nanoparticles.

Age dependent tolerance to parasitism: Trematode infections in tadpoles of common hourglass tree frog (*Polypedates cruciger*)

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When exposed to parasites, hosts increase their fitness by either increasing resistance to parasites (parasite burden) or by increasing tolerance (reducing the harm caused by a given parasites load). Among amphibians, the older tadpoles are known to have higher tolerance to trematode infections than younger tadpoles. Here we examined the age dependent tolerance of the tadpoles of common hourglass tree frog (*Polypedates cruciger*), exposed to pleurolophocercous cercariae under laboratory conditions. Pleurolophocercous cercariae released from freshwater snail, *Melanoides* sp. were exposed to tadpoles at 10, 20 and 30 days post-hatch (Gosner stages 27, 28/29, 30/31, respectively) in a dose-dependent manner (control= 0, low=16, medium =32, high =48). Sixty tadpoles were used for each stage with a total of 180 tadpoles. A control tank was setup without introducing cercariae. Survival, growth [snout-to-vent length (SVL) and body mass], time required for fore limb emergence of half of the number of tadpoles (TE_{50}) and development of malformations were recorded in tadpoles and metamorphs. Overall, infection at 10 and 20 days post-hatch stage resulted in significantly low survival (40.0% and 53.4%; Chi square test, $p < 0.05$) but not when the exposure age increased to 30 days post-hatch (96.7%). Cercariae exposed tadpoles developed malformations and the types of malformations developed were mainly axial such as kyphosis and scoliosis. Overall percentage of malformations was higher in younger tadpoles than older ones (10 days = 71.4%; 20 days= 56.2% and 30 days= 28.5%). Older tadpoles had a higher tolerance to parasitism than the younger tadpoles. The growth of exposed tadpoles was also affected. The SVL, body weight and TE_{50} values showed that the tadpoles exposed at early stages were smaller in size and took longer time to metamorphose.The magnitude of the effects decreased with the age of the tadpole and this may have fitness consequences in natural context. Since the cercariae are relatively large, they may have impeded the smaller tadpoles at early stages of development. The harm caused by the parasite at a given parasitic dose was less in older tadpoles showing an age dependent tolerance to parasitism by the tadpoles of *P.cruciger*.

Susceptibility status of Spinose ear tick, *Otobius megnini* (Acari: Argasidae) to selected acaricides

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The spinose ear tick, *Otobius megnini* is a one-host, nidicolous soft tick whose larvae and nymphs parasitize a wide range of domesticated animals and occasionally humans. In Sri Lanka, *O. megnini* has been reported only from Nuwara Eliya causing otoacariasis in horses and humans. The larval activity of this tick increases during warmer and dryer months. Although *O. megnini* infestation is a major constrain in stabled racehorses in Nuwara Eliya, use of acaricides has never been practiced as a control measure. The present study was carried out to assess the susceptibility of *O. megnini* larvae to DDT (organochlorine), malathion (organophosphate), permethrin and flumethrin (pyrethroids). Engorged nymphs were collected from 14 thoroughbred stabled horses from the racecourse in Nuwara Eliya and were allowed to moult into adults at 28± 2ºC and 80% RH under laboratory conditions. Eggs from 100 mating pairs were mixed and placed in perforated Eppendorf® tubes (150 eggs each) until hatched out. Resistance status of larvae was assessed according to Larval Packet Test (LPT) as recommended by the Food and Agriculture Organization (FAO). Larvae were exposed to a series of different acaricide concentrations. The technical grade acaricide was dissolved in a mixture of olive oil and acetone (1:2) and serially diluted to produce the 7-10 test dosages between 0.00001 and 10 % W/V. For each dilution, a larval packet was made and approximately 150 larvae (14-21 days old) were inserted into it. After a 24 hour exposure, live ticks were counted and percentage of larval mortality was plotted against log-transformed acaricide concentration. Susceptibility of the larvae and resistance discriminating dosages (RDD) were determined according to FAO and World Health Organization (WHO) guidelines. The LC_{50} values (% W/V) for malathion, flumethrin, permethrin and DDT were 0.0106%, 0.0003%, 0.0077% and 0.1239%, respectively and the resistance percentages were 2.9%, 0.1%, 5.4% and 13.8%, respectively. Flumethrin was the most effective acaricide against *O. megnini* since the tick population was susceptible to flumethrin according to the RDD given for Australian strains of *R. microplus*. The population of *O. megnini* showed possible presence of resistance to malathion and permethrin. Percentage mortality against DDT was 86.2% indicating a very high level of resistance. Although DDT has hardly been used as an acaricide in Sri Lanka, its extensive use in antimalarial programs in the country during early 1950s to 1977 might have exposed Sri Lankan tick populations to DDT causing resistance development. Alternatively, ticks may have acquired cross-resistance to DDT after being exposed to other insecticides. Resistance to malathion and DDT was heterogeneous (Chi-square test; $\chi^2 = 28.1$ and $\chi^2 = 51.5$, respectively; $p<0.05$). The study reveals an emerging resistance to permethrin and malathion perhaps due to the exposure of tick population to environmental insecticide contaminations.

Life cycle of *Hyalomma isaaci* (acarina: ixodidae) under laboratory conditions

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Hyalomma isaaci is a hard tick infesting mainly cattle and buffalo in all over Asia and in Sri Lanka. Human infestations of *H. isaaci* have been reported from Sri Lanka especially related to otoacariasis. This study was conducted to describe the biological and reproductive parameters of the two host life cycle of Sri Lankan population of *H. isaaci* under laboratory conditions. Engorged wild female ticks were collected from cattle and buffaloes from Polonnaruwa district and were allowed to lay eggs in the laboratory (Temperature 27 ± 1 ^{o}C; Relative Humidity 70%-80%). The larvae hatched out from the eggs were used for experimental infestation on New Zealand white rabbits. The life cycle completed within 62 - 166 days. Females laid 15-6166 eggs for 1-24 days after spending a latent period of 3-14 days. Newly emerged larvae were under incubation for 19-47 days and after they resumed feeding, they moulted attached to the host itself. Subsequently, newly emerged nymphs were reattached for feeding and fully engorged nymphs were collected after 15-21 days from the introduction of larvae for feeding. Successively the nymphs took 14-18 days for moulting before emerging as adults. Females fed on rabbits for 8-10 days reached a maximum engorgement weight of 127.0 mg. The male: female sex ratio was 2:3 in the adults which were moulted under laboratory conditions. Mean Reproductive Efficiency Index (REI) and Reproductive Affinity Index (RAI) were 7.1 and 3.6, respectively. There was a strong significantly positive correlation in weight of the female with the number of eggs laid (rho = 0.774, $p<0.01$) and percent eclosion (rho = 0.891, $p<0.05$). Similarly, significant positive correlations were found between REI and RAI with the female weight (rho =0.686 and 0.932 respectively, $p<0.02$). Larger females laid higher number of eggs. When New Zealand rabbits were used as hosts under 27°C±1 and 70% humidity, *H. isaaci* completed its full life cycle however the mature stage did not feed successfully as immature stages.

Facile synthesis of hydroxyapatite (HA)-polymethylmethacrylate (PMMA) nanocomposites by a novel ex-situ polymerization method: morphology, thermal stability and formation mechanism of HA particles in nanocomposite

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Demand for bone grafts in the global surgical market is very high due to frequent occurrence of bone defects either from traumatic or from non-traumatic destruction. Since bone is a typical example of a nanocomposite, designing a bone graft in the form of a nanocomposite can be advantageous over monolithic or microcomposite materials. Mainly due to the lack of clinical data supporting long-term performance and the prevalence of complex methodologies, the use of nanocomposites in bone grafting is very much less than expected. Therefore, in this study, clinically well-known substances, such as HA nanoparticles and methyl methacrylate (MMA) were used to synthesize HA-PMMA nanocomposites by a novel ex-situ polymerization method.

Nanosized HA spherical particles (~17 nm) were dispersed in PMMA matrix while PMMA was synthesized using its monomer (MMA) with the presence of $K_2S_2O_8$ initiator at 80 °C. The nanocomposite was characterized using X-ray diffraction (XRD), Scanning electron microscopy (SEM), Thermo-gravimetric analysis (TGA) and Differential scanning calorimetric (DSC) analysis.

Particle size of HA was calculated using the XRD pattern, applying Debye-Scherer formulae, giving the dimensions of the HA crystals to be 43 nm and 158 nm in the nanocomposite. According to the SEM images and obtained dimensions in the XRD patterns, spherical HA nanoparticles may self-assemble in the PMMA matrix to plate shaped particles. Initially, MMA may have strong interactions with spherical HA nanoparticles in the 'a' axis direction as 'c' axis direction ((001) surface) is considered as the non-dipolar surface of HA. Upon polymerization of MMA, HA nanoparticles may get closer in the 'a' axis direction and strong interactions with MMA may be released as radical polymerization is more favourable, so that allowing self-assemble into plate shape structures. TGA and DSC analysis shows that thermal stability enhanced in the HA-PMMA nanocomposite when compared with PMMA alone, showing existence of some strong interactions between HA nanoparticles and the PMMA matrix. Therefore, enhanced mechanical properties can be expected in the synthesized nanocomposite.

Thus, in the novel one pot synthetic route, HA-PMMA nanocomposite, with a higher thermal stability can be obtained, which can be used as a bone grafting material.

Prevalence of *Wolbachia* infection in mosquito populations in Sri Lanka

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During the last ten years, intensive research efforts have provided evidence that insect symbionts like *Wolbachia* can be useful tools for the control of major agricultural pests and disease vectors, including *Aedes* mosquitoes. The objective of the present study was to determine and characterize the presence of *Wolbachia* infections in wild mosquito populations in Sri Lanka in order to identify suitable strains which may be useful in the combined SIT / IIT approach. Adult mosquitoes were collected from 15 selected districts in Sri Lanka namely; Gampaha, Colombo, Galle, Matara, Hambanthota, Jaffna, Mannar, Ampara, Trincomalee, Batticaloa, Anuradhapura, Kandy, Kegalle, Badulla and Nuwara Eliya from October, 2014 to March, 2016. Mosquitoes were identified into the species leveland stored in -20 ^{0}C freezer after labeling until taken for molecular analysis. The field caught mosquito specimens were processed for the genomic DNA extraction individually using Qiagenkits (Qiagen DY14, Hilden, Germany). The DNA amplification was carried out using a specific pair of primersthat recognizes the 16S *rRNA* gene of *Wolbachia*. Primers which amplify the gene encoding for the major *Wolbachia* surface protein (*wsp*) were also used for screening in order to confirm the results. Two negative controls (*Wolbachia* un-infected mosquito DNA and milli-Q water) and one positive control (*Wolbachia*double infected *Aedes albopictus* Thailand strain) were used at each Polymerase Chain Reaction (PCR). Each PCR product of 5µl was subjected to gel electrophoresis and visualized in gel image system. The results were compared with the marker (100bp ladder) in an attempt to identify band sizes of about 1 kb and 540-632bp for the 16S *rRNA* and *wsp*genes, respectively. The experiment was conducted for 3, 24, 2, 5, 16, 7 and 21 species from each mosquito genus *Tripteroides, Anopheles, Toxorhynchites, Mansonia, Aedes, Armigerus* and *Culex* respectively. For confirmation of the results, each PCR reaction was repeated three times.PCR amplicons were further analyzed by nucleotide sequencing, Blastn search and sequence alignment. Accordingly, a total of 78 mosquito species were screened and twelve (12) of them namely; *Mansoniaindiana, Mn. uniformis, Mn. annulifera, Aedesalbopictus, Ae. pseudalbopictus, Armigeressubalbatus, Ar. flavus, Culexgelides, Cx. quinquefaciatus, Cx.sinensis*and*Cx.sitiens*were positive by both PCR assays. None of the *Anophele*s species or *Aedesaegypti* was found infected with *Wolbachia*. Sequence analysis indicated significant genetic diversity among the various *Wolbachia*strains detected.

Extraction of silica from selected Sri Lankan traditional rice husks

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Rice is a staple food in Sri Lanka and most of the other South Asian Countries. Rice husk (RH) is one of the most abundant agricultural wastes available in rice producing countries. Following the green concept, there is a significant interest of converting this waste material into useful value added product. RH can be used as a fuel and then as the silica source. Gonabaru, Kahawanu, Patchaperumal, Dahanala and Suwandel are some of the traditional rice varieties, which are becoming popular due to the awareness of medicinal and nutritional values. The objective of this research is to extract silica from traditional RHs.

Moisture content, ash content, volatile matter and fixed carbon of RH were determined as the proximate analysis of RH, comparatively with that of the improved one. Ash content of RHs of traditional rice varieties (more than 20.0%) was higher than that of the genetically improved one (~13.1%). Acid washing step is required to purify white rice husk ash (WRHA). The mineral content of WRHA was determined using atomic absorption spectrometer (AAS). WRHA of both traditional rice varieties and genetically improved rice variety (BW 364) contains relatively higher amount of K (0.97% - 1.24%). But WRHA of traditional rice varieties contains lower content of Fe (0.01% - 0.02%) and WRHA of BW 364 contains lower content of Mn (~0.006%). Percentage of reduction (PR) of minerals has been calculated. According to the PR values, almost all the minerals have been leached out through the acid washing step.

Acid washed WRHA was used to extract silica as it is an economically valuable material. High silica content was extracted from RHs of traditional rice varieties (more than 23.0%) than that of BW 364 (~16.2%). Major chemical groups present in rice husk silica (RHS) were determined using fourier transform infrared (FTIR) spectra. FTIR spectrum of RHS was almost similar to the FTIR spectra of commercially available precipitated silica and silica used for thin layer chromatography (TLC – GF254). TLC plates prepared using RHS worked almost similar to the laboratory available TLC plates. Therefore there is a potential usage of RH.

Use of acrylic based hydrogels for pre-concentration of trace level lead ions

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The analysis of ultra-trace level (ppb) lead requires either sensitive and expensive analytical instrumentation (GFAAS, ICP-MS etc) or extraction and preconcentration to higher levels (ppm) for analysis in relatively low cost instrumentation (FAAS or spectrophotometry). The adsorption of Pb(II) ions from aqueous solutions onto poly(acrylic acid-co-acrylamide) (PAAAM) hydrogels was investigated to assess the preconcentration potential of PAAAM for lead ions. Crosslinked copolymers of acrylic acid (sodium acrylate) and acrylamide were synthesized by free radical polymerization. The polymerization process was initiated by ammonium persulphate (APS). N,N,N,N-tetramethylethylenediamine (TMEDA) was used as an accelerator and N,N'-methylenebisacrylamide (MBA) was employed as a crosslinking agent.

The swelling ratio was found to be affected by the change in acrylamide (AM) content and ionic strength. The effect of acrylamide (AM) content in the copolymer hydrogel, pH, initial lead level, ionic strength and contact time on Pb(II) ion adsorption were investigated. With an increase in the content of acrylamide (AM) in PAAAM, the swelling ratio of PAAAM hydrogel decreased. The swelling ratio also decreased rapidly with the ionic strength at the room temperature. The acrylamide content and the ionic strength showed significant effect of Pb(II) adsorption on prepared hydrogel. The ability of the PAAAM hydrogels to bind Pb(II) ions was examined at different pH values and lead levels at room temperature. The maximum Pb(II) ion adsorption was observed in the pH range of 5 - 6. Variation of contact time of metal ion solution with PAAAM hydrogel showed that equilibrium was reached within first two hour time period.

The adsorption equilibrium data were better fitted by a Langmuir isotherm, while the adsorption kinetics was better described by the pseudo second order model at the room temperature. FT-IR spectra before and after adsorption of Pb(II) on PAAAM hydrogel was obtained to identify the possible functional groups responsible for the metal ion adsorption. Ultimately this study showed that the prepared poly(acrylic acid-co-acrylamide) (PAAAM) hydrogel can be used as a direct solid phase extraction tool to pre-concentrate Pb(II) ions in the range of 10-100 ppb to 2- 10 ppm.

Use of acrylamide based hydrogels for
pre-concentration of trace level chromium ions

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The determination of trace level (ppb) metal ions by low sensitive flame atomic absorption spectroscopy (FAAS) requires sample pre-concentration procedures. In this study, Poly (acrylamide-co-maleic acid) hydrogel (PAMMA) was prepared by free radical polymerization in the presence of cross linking agent (N,N'-methylenebisacrylamide), initiator (ammonium persulphate) and accelerator (N,N,N,N-tetramethylethylenediamine) to study the pre-concentration potential of chromium ions.

The swelling behavior and adsorption capacities were studied at various maleic acid levels at different pH values. The prepared hydrogels showed good swelling behavior that was highly dependent on the pH of the medium. The maximum swelling ratio of 108 was observed at pH = 7.

The affinity of trivalent chromium (Cr^{3+}) and hexavalent chromium (CrO_4^{2-}) for PAMMA hydrogels were studied at pH 4 where hydrogels were partially deprotonated. The results indicated that affinity of trivalent chromium was significantly higher than that for hexavalent chromium ions. Therefore poly (acrylamide-co-maleic acid) hydrogel was selected to pre-concentrate trivalent chromium. The critical factors such as pH, ionic strength, acrylamide-maleic acid ratio and cross-linking density were also studied for the optimization of adsorption capacity of prepared hydrogels for trivalent chromium absorption. Maximum adsorption capacity was observed when the acrylamide: maleic acid molar ratio was 7:4. With the increase of crosslinking density, the adsorption capacities decreased. The adsorption capacity also dropped with ionic strength. It was found that the absorption capacity dropped from 42.3 to 26.3 mg g^{-1} when ionic strength was increased from 0.01 to 1.

The optimum uptake of Cr^{3+} was found to be at pH 5 and the equilibrium contact time was reached at around 4 hours. Adsorption mechanisms were studied by both Langmuir and Freundlich isotherm models at room temperature (29 ^{0}C) and it was found that the adsorption behavior was better explained by Freundlich isotherm. The kinetic studies of trivalent chromium indicated that the rate of adsorption followed pseudo second-order kinetics at room temperature.

Pre-concentration factors of Cr^{3+} at optimum conditions in different initial concentrations were studied at non-competitive conditions. Very good linear correlation of the prepared trivalent chromium solutions at ppb levels and the pre-concentrated solutions was found. The linear correlation co-efficient (r^2) of 0.998 indicates that poly (acrylamide-co-maleic acid) hydrogel can be used to pre-concentrate trivalent chromium in the range of 40 - 70 ppb into 2-10 ppm range.

Electropolymerization of partially purified natural terthiophenes extracted from roots of *Tagetes erecta*

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To fulfill the growing global energy demand, harvesting energy directly from the sunlight, using solar cells, is considered as one of the best methods available. Conjugated polymers have significant influence in changing the perception of solar cell materials due to low cost and manufacturing simplicity compared to conventional Si-based solar cells. It has been shown that the inorganic polymers can be replaced by organic conjugated polymers to construct the organic solar cells.

Polythiophene with both doped and undoped states, are one of the major categories of conjugated polymers used in organic solar cell applications. Starting materials of polythiophenes are commonly obtained from nonrenewable sources such as petroleum byproducts and their price may vary with the crude oil price. Green thiophene derivatives are reported in roots of *Tagetes sp.* The current study discusses electropolymerization of polythiophenes from hexane soluble fraction (HSF) of partially purified roots extract of thiophene derivatives from the *Tagetes erecta*.

In literature, several thiophene derivatives were identified in the root extracts of *Tagetes erecta* including 5-(3-buten-1-ynyl)-2,2-bithienyl, 5-(4-hydroxy-1-butynyl)-2,2-bithienyl, 5-(4-acetoxy-1-butynyl)-2,2-bithienyl and 2,2:5,2-terthienyl (terthiophene). In this work, crude extract of *Tagetes erecta* was partially purified and partitioned into hexane. Partitioning of thiophene derivatives into hexane was confirmed by GCMS studies.

According to GCMS data, terthiophene is the only possible compound in HSF that can undergo electropolymerization. Cyclic voltammetric study was carried out to characterize the redox potential of terthiophenes in HSF and oxidation of terthiophenes was observed at 1.05 V. Electropolymerization of terthiophenes was carried out in acetonitrile medium under inert environment and $LiClO_4$ was used as the electrolyte. During the electropolymerization, a thin layer was formed on the anode surface.

Electropolymerized products from HSF were characterized using FTIR, UV-Visible Spectroscopy and powder X-ray diffraction techniques and those were compared with the results of the electropolymerized product of pure thiophene monomers. These results further confirmed the possibility of electropolymerization of terthiophenes from the HSF of *Tagetes erecta*, to obtain highly crystalline polythiophenes.

Abstract No: 96 (Poster) *Natural Sciences*

Heavy metal biosorption by Alginic acid extracted from *Sargassum* sp.

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Water is the driving force for many natural processes on the earth. It is essential to protect the quality of water for the survival of all living beings. However, water pollution has increased significantly during the last few decades with the rapid industrialization processes. This work highlights a development of a low cost, sustainable and efficient water purification sorbent extracted from a seaweed species grown in the coastal areas of in Sri Lanka.

Alginic acid extracted from *Sargassum* sp. collected at the coast of Beruwela has been studied extensively as a candidate material to remove metal ions from natural and waste waters. The extracted alginic acid was characterized using FTIR spectroscopy. Metal absorption capacity, selectivity and the extent of reusability of alginic acid were determined for the metal ions (Pb^{2+}, Cu^{2+}, Zn^{2+}, Co^{2+}, Ca^{2+}, and Mg^{2+}) by using respective metal ion solutions. Alginic acid has shown maximum adsorption towards Pb^{2+} ions with 488.5 mg/g capacity. Adsorption capacity for metal ions Cu^{2+}, Zn^{2+}, Co^{2+}, Mg^{2+} and Ca^{2+} ions were 314.4 mg/g, 287.4 mg/g, 283.8 mg/g, 83.6 mg/g and 74.4 mg/g respectively. It showed more selectivity towards Pb^{2+} ions over the other ions in a metal ion solution. Reusability of the aliginic acid for two adsorption-desorption cycles were experimented and determined that the metal ion removal capacity remains fairly constant. Furthermore, alginic acid showed an ability to remove Pb^{2+} ions completely from Pb^{2+} spike natural water sample, which initially contained 5.0 mg/L Pb^{2+} ion concentration. Ca^{2+} and Mg^{2+} ions removal capacities of alginic acid from natural water system were 57.5 mg/g and 36.6 mg/g respectively.

It can be concluded that alginic acid is an economical, sustainable remedy for water purification in Sri Lanka to remove heavy metal ions from waste water.

Modification of apatite from Eppawala rock phosphate deposit (ERPD) to be used in advanced materials: removal of fluoride and particle size reduction

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Apatite has more important applications as a vital raw material in orthopedics, dentistry, etc than its traditional use as a fertilizer. Eppawala apatites (EpAp) are chemically identical and basically composed of chlorofluoroapatites and weight percentage of fluoride in EpAp was found as 1.5 – 2.1%. To be used in advanced materials, purification of EpAp will be advantageous. Therefore, in this study, heat treatment of EpAp was carried out to investigate the removal of fluoride and effect on particle size was studied as particle size reduction is beneficial to enhance certain properties.

Physically separated apatites from ERPD were ball milled and heated at different temperatures for different time periods using a thermo gravimetric analyzer (TGA) with monitoring the removal using SPADNS spectrophotometric method as well the weight loss and heat flow, using TGA and DSC curves respectively.

TGA curve of EpAp shows there is a weight loss upon heating after reaching the temperature 700 °C. According to the SPANDS spectrophotometric analysis, about 8% of fluoride can be removed by heating EpAp to 900 °C for 1 hour.

According to the TGA curves, percent removal of fluoride can be increased, when sample was kept at 900-1000 °C for an extended time period. Shifting of broad endothermic peak around 600 °C, towards higher temperatures and decrease in percent removal with progressive TGA runs for a sample, indicate the difficulty of removal of interior fluorides in the EpAp crystal structure. Powder X-ray diffraction (PXRD) patterns reveal that heat treatment does not effect on the apatite crystal structure. However, calculations of particle sizes along a-axis and c-axis and SEM images show reductions in particle size and some differences in the shapes upon heating. Particle size reduction may be due to the removal of fluoride from their lattice sites of EpAp lattice leading to the breakdown of extended EpAp crystal structures.

Thus, in this simple heating method, F[-] removal from EpAp can be achieved around 700 °C and upon increasing the temperature and duration, the amount removed can be increased and particle size can be reduced. In addition, crystal structure can be maintained up to the studied temperature (~1000 °C).

Zinc and copper organic frameworks as heterogenous catalysts for the esterfication of stearic acid

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Esterification is a vital transformation in many commercially important processes. A catalyst is essential for efficient esterification. Widely available homogenous catalysts do not satisfy the need since the separation of the catalyst at the end of the reaction causes difficulties. Therefore, the need of a heterogeneous catalyst has been a topic of current interest. In this study, metal (M=Zn and Cu) organic frameworks (MOFs) were synthesized under traditional solvothermal conditions and their catalytic activity in the process of esterification was studied. MOFs were synthesized by refluxing $M_n(CH_3COO)_2.2H_2O$ and teriphthalic acid in *N,N*-dimethyl formamide at 60 °C in 1:2 molar ratio for 4 h. The resulting white powder of Zn-OF and blue powder of Cu-OF were collected by filtration and characterized by comparing their PXRD and FTIR spectra with the previously reported data. The grain diameters were calculated according to the Debye-Scherrer formula and the calculated values were 280.44 nm and 223.32 nm for Cu-OF and Zn-OF respectively. To test the catalytic activity, stearic acid (0.100 g) was refluxed with the MOFs (0.010 g). Resulting solutions were centrifuged and the supernatant layer was separated and a GC analysis was carried out. Control experiments were carried out without the application of a catalyst. Both MOFs revealed catalytic activity for the esterification of stearic acid. The catalysts were heterogeneous so that the easy separation after the completion of the reaction was possible. GC data revealed that Zn-OF has higher capacity (~13.31%) than that of the Cu-OF for the conversion of stearic acid into fatty acid methyl ester. The esterification reaction in the presence of Cu-OF is more efficient (~2.20%) than that in the absence of a catalyst. The overall results reported herein implies the higher catalytic activity in the presence of better Lewis acids such as Zn-OF than Cu-OF

Abstract No: 152   *Natural Sciences*

Host preferences of frog-biting *Uranotaenia* mosquitoes in Sri Lanka

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Hematophagous insects often have particular host preferences to maximize their foraging efficiency that result in close ecological associations with their victims. Identification of host preference of blood feeding mosquitoes is vital to understand how disease causing pathogens transmit among wild- animals and from wild-animals to humans. The objective of the present study was to uncover the host preferences of frog-biting mosquitoes in Sri Lanka.

Feeding behaviour of frog-biting mosquitoes and calling activities of anurans (ground dwelling *Duttaphrynus melanostictus*, arboreal *Polypedates cruciger* and *Pseudophilautus rus*) were examined once a week from April 1st to June 30th 2016 at a home garden in Ranawana, Katugastota. Mosquitoes attracted to frog calls were collected at hourly intervals from 19.00 to midnight. Sound traps were also used to collect mosquitoes that responded to *D. melanostictus* calls. Collected mosquitoes belonged to the genus *Uranotaenia* and were identified as three morphotypes (*Ur.* sp1, *Ur.* sp2 and *Ur.* sp3). These *Uranotaenia* morphotypes had different host preferences towards anurans at the study site and shared temporal and spatial niche partitioning with their preferred host anurans. The highly abundant *Uranotaenia* sp1 (n=1271) was often found at ground level, and mostly attracted towards ground dwelling *D. melanostictus* (98.1%). The sound trap (n=5 traps) with *D. melanostictus* calls at natural intensities also attracted 100% *Ur.* sp1 (n=45) supporting the species specific interactions between them. Moderately abundant *Uranotaenia* sp2 (n=441) often inhabited an average height of 0.7 ± 0.1m, and mostly bite *P. rus* (98.6%) that was abundant at 0.7 ± 0.1m. The least abundant *Ur.* sp3 (n=42) was often found at an average height of 1.4m and was attracted to *P. cruciger* (97.6%). Peak activity hours of *Ur.* sp1 (22.00-23.00 hrs), *Ur.* sp2 (19.00-20.00 hrs) and *Ur.*sp3 (20.00-21.00 hrs) overlapped with active peak hours of *D. melanostictus*, *P. rus* and *P. cruciger* respectively. Our results revealed high species-specificity between the mosquitoes and their anuran host highlighting host niche partitioning in a relatively simple community for the first time in Sri Lanka. Future studies will explore the factors that influence the evolution of species-specific interactions between mosquitoes and anurans in Sri Lanka.

Determination of optimum nitrate and phosphate concentrations for maximum growth of *Chlorella* Sp.

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Algae biomass can be used for various purposes such as biofuel production, extraction of high value added food and pharmaceutical products. While growing algae for such purposes, removal of nitrogen and phosphorous from waste water polluted from nitrogen and phosphorous sources also can be achieved by growing algae. To obtain maximum algae growth, both physical and chemical parameters can be optimized. Controlling physical parameters are quite expensive rather than controlling chemical parameters such as nutrients and pH of the medium. Therefore, outdoor conditions with different nutrient contents were used. Nitrogen, phosphorus and potassium are the most significant macronutrients for algal growth. In this research, inorganic phosphate (PO_4^{3-}) and inorganic nitrate (NO_3^-) were used as the nitrogen and phosphorus sources, respectively, in order to find the best NO_3^- : PO_4^{3-} concentration and the best N: P atomic ratio for the maximum *Chlorella* sp. growth. The growth measurement of cell density was taken using UV-Visible Spectroscopy and specific growth rate (μ) was calculated. According to previous research, N: P atomic ratio is the most significant factor for algae growth where N: P = 16:1 for the maximum growth. However according to our results, not only the N: P atomic ratio, but also NO_3^- and PO_4^{3-} concentrations were equally important for algal growth. Under the experimental conditions, the maximum specific growth rate (μ_{max}) was observed when the concentrations of NO_3^- and PO_4^{3-} were kept at 200 ppm and 10 ppm respectively, where N: P atomic ratio was 14: 1. However, under the same N: P ratio (14:1) at different NO_3^- : PO_4^{3-} concentrations (when $NO_3^- > 200$ ppm and $PO_4^{3-} > 10$ ppm) the maximum growth was not observed. The pH of the medium also increased significantly with the growth of algae. This study demonstrated that optimum nutrient conditions maximize the algae growth under outdoor conditions and their nutrient removal capability can be used for waste water treatment.

Abstract No: 161   *Natural Sciences*

Genetic diversity and population structure of malaria vector mosquitoes *Anopheles peditaeniatus, An. subpictus* and *An. vagus* (Diptera: Culicidae) in five districts of Sri Lanka

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Anopheles subpictus is the secondary vector and *An. peditaeniatus* and *An. vagus* are potential vectors of malaria in Sri Lanka. Understanding population structure of vectors is vital in implementing successful vector control programmes to face the threat of re-emergence of malaria in Sri Lanka. This study reports the genetic diversity and the population structure of *An. peditaeniatus, An. subpictus* and *An. vagus* in five geographical locations in Sri Lanka using their mitochondrial gene, *Cytochrome oxidase subunit* I (*COI*). Adults were collected from Ampara, Badulla, Batticoloa, Jaffna and Kurunegala districts and the *COI* sequences were obtained from morphologically identified species using Polymerase Chain Reaction (PCR) assay. Statistical analyses were conducted using Dnasp 5.10.01 and Arlequin 3.11.

An. peditaeniatus, An. subpictus and *An. vagus* had 8, 15 and 10 haplotypes respectively. All the three species had high genetic diversities. *An. subpictus* had the highest nucleotide diversity (0.025 ± 0.011) while *An. peditaeniatus* had the lowest (0.007 ± 0.002). According to neutrality tests, there is no positive selection driven in any of these species. No significant pairwise differences or genetic structure variations among *An. peditaenatus* or *An. vagus* populations which shows that random mating occurs among different populations of each species.

A significant pairwise difference was observed between Jaffna (northern province) and Kurunegala (northwestern province) *An. subpictus* populations (F_{ST}= 0.965,)*. This strongly supports the previous reports on the p*resence of two different sibling species of *An. subpictus* in these two provinces. *Analysis of Molecular Variance (AMOVA) results showed* 82.21% significant genetic structure variation between *An. subpictus* populations (F_{CT}= 0.822) compared to a smaller 17.79% variation within populations (F_{SC}= 1.000), suggesting the existence of different *An. subpictus* sibling species in different geographical areas.

The present study shows that geographic distance between populations has no effect on the population structures of *An. peditaeniatus* and *An. vagus* but affects the population structure of *An. subpictus.* Application of control measures against *An. subpictus* must be done with close monitoring since similar control measures may not be effective for all the populations and the high genetic variation can give rise to the population's resistant to control measures.

Natural Sciences

In vitro release study of Linamarin encapsulated Chitosan nanoparticles

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Linamarin, a cyanogenic glycoside has exhibited the potential as a drug candidate for cancer treatment. Nano-based delivery system will be a suitable application for selective and safe delivery of linamarin. Chitosan (CS) nanoparticles have gained more attention as effective drug carriers in cancer chemotherapy because of their better stability, biocompatibility and for possessing versatile routes of administration. This study focused on the fabrication, physicochemical characterisation and controlled release properties of linamarin encapsulated CS NPs.

Linamarin loaded nanoparticles were prepared by incorporating linamarin into CS solution followed by drop wise addition of the TPP. The selected mass ratio of CS: TPP was 6:1. The particle size and zeta potential value were 49 ± 2 nm and 52 ± 3 mV, respectively. Entrapment efficiency of 85 ± 6 % was achieved with a weight ratio of 150:1 (CS: linamarin). Nanoparticles were characterised using FT-IR, thermo gravimetric analysis (TGA), TEM and SEM techniques. The shape of NPs particles was approximately spherical according to SEM and TEM analysis. FT-IR results suggested cross-linking and interactions between linamarin and CS as well as CS and TPP. TGA analysis also proved the incorporation of linamarin into CS nanoparticles. *In vitro* release characteristics of linamarin from CS NPs were investigated in buffer solutions with pH 2 (KCl-HCl) and 7.4 (phosphate buffer saline).Release profile in both pH values appeared to have an initial rapid release followed by a controlled release behavior. Released amounts of linamarin at 120 h were 68.83% with pH 7.4 and 70.79% with pH 2.

Smaller size and positive zeta potential for linamarin loaded CS nanoparticles indicate their potential for cellular uptake, long circulation and retention time inside the body. Controlled/sustained release behavior enhances the bio availability of the drug, reducing possible side effects. Therefore targeted delivery of linamarin using CS nanoparticles will be an effective, promising alternative method to other cancer treatment methods.

Synthesis, characterization and investigation of antimicrobial activity of monomeric ni(ii) and co(ii) complexes of a schiff-base ligand synthesized from 2, 4-dinitrophenylhydrazine and acetyl acetone

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The chemistry of Schiff-base transition metal complexes has attracted the interest of both inorganic and bioinorganic chemists in recent years mainly due to their catalytic and microbiological activities. Therefore, the present study was focused on the antimicrobial activity of a Schiff-base ligand (L) and its Ni(II) and Co(II) complexes as the chemistry of these metal complexes can be monitored easily using spectroscopic techniques. L was prepared by refluxing ethanolic solutions of 2, 4-dinitrophenylhydrazine and acetyl acetone in 2:1 molar ratio. Ni(II) and Co(II) complexes were synthesized according to the template synthesis method. All the complexes were characterized by FTIR, H^1-NMR and UV-Vis spectroscopic techniques. According to the FTIR spectra, both bands at 1635 cm^{-1} and 3441 cm^{-1} corresponding to the C=N imine and N-H vibrations respectively, have shifted to lower frequency (1330-1615 cm^{-1}) due to the complex formation. Metal-L bond formation is confirmed due to the presence of a band around 530-550 cm^{-1} corresponding to the ν (M–N) vibrational mode. The UV-Visible spectra of L exhibits intense absorption peaks at 217 and 345 nm. L incorporation to the metal is evident due to the presence of highly intense bands around 215-300 nm and 305-360 nm in both Co(II) and Ni(II) complexes. The main peaks of ^{1}H NMR of L and the Ni(II) complex in $CDCl_3$ are similar; the aromatic, CH_3, CH_2 and N-H protons appear in the range 7.2-8.9, 2.1-2.2, 3.3 and 4.0 ppm, respectively. Antibacterial activity of the synthesized L and the complexes were determined using thin-layer chromatography with direct bioautography for *Escherichia coli* sp. Antifungal activity was studied using well diffusion method for *Cladosporium* sp. According to the results, both free ligand and its Co(II) and Ni(II) complexes show antibacterial activity. Antibacterial activity of metal complexes is higher than that of the free ligand. In contrast, antifungal activity was higher for the free ligand than the metal complexes. Overall results of this study reveal that the L, Ni(II) and Co(II) complexes can be used as antifungal and antibacterial agents.

Natural Sciences

A series of isocoumarins from an endophytic fungus *Biscogniauxia capnodes* from *Phyllanthus acidus*

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Microbial natural products play major role in applications in agriculture, medicine, cosmetics and food industry. Fungi are living eukaryotic organisms and can be categorized into epiphytic fungi and endophytic fungi. Endophytic fungi reside in internal plant tissues of higher plants whilst epiphytic fungi grow on the surface of plants. As a continuation of our studies on chemistry and bioactivity of fungi associated with edible fruits of Sri Lanka, secondary metabolites produced by an endophytic fungus isolated from popular edible *Phyllanthus acidus* fruits was studied.

Phyllanthus acidus (goose berry) is a tree of family Phyllanthaceae. An endophytic fungus *Biscogniauxia capnodes* was isolated from the fruits of *P. acidus*, and identified by molecular means. Pure cultures of *B. capnodes* were inoculated into potato dextrose broth (PDB) media, allowed to stand for a week and then incubated at room temperature for another two weeks while shaking every other day on a laboratory shaker. The culture broth and mycelium were separately extracted with EtOAc and the residual mycelium was further extracted with MeOH. According to the similar TLC analysis, the two EtOAc extracts were combined. The EtOAc and MeOH extracts were subjected to bioassays for antioxidant activity (against DPPH radical scavenging), phytotoxicity against lettuce (*Lactuca sativa*) seed germination inhibition and antifungal activity (against *Cladosporium cladosporioides*). The EtOAc extract showed positive response in antifungal, antioxidant and phytotoxicity bioassays. Chromatographic separation of EtOAc extract furnished seven compounds. These compounds were identified as six isocoumarins, 8-hydroxy-3,5-dimethylisochroman-1-one (**1**), 8-methoxy-3,5-dimethylisochroman-1-one (**2**), 7,8-dihydroxy-3,5-dimethylisochroman-1-one(**3**), 6-methoxy-8-hydroxy-3-methyl-1H-isochromen-1-one (**4**), 8-hydroxy-6,7-dimethoxy-3-methyl-1H-isochromen-1-one (**5**), 6,8-dihydroxy-7-methoxy-3-methyl-1H-isochromen-1-one (**6**), 5-methylbenzene-1,3-diol (**7**), by detail analysis of ^{1}H & ^{13}C NMR data and comparison with reported data. This is the first report of isolation of an endophytic fungus *Biscogniauxia capnodes* from the fruits of *P. acidus* as well as isolation of isocoumarins as metabolites from the fungus *B. capnodes*.

Natural Sciences

Isolation and characterization of spiciferone A from an endophytic fungus *Phoma macrostoma* isolated from *Artocarpus altilis* fruits

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This study focuses on the chemistry and bioactivity of secondary metabolites produced by an endophytic fungus from the fruit of *Artocarpus altilis* (family Moraceae). *A. altilis*, commonly known as "Del" in Sri Lanka. Its fruits are known as breadfruit and cooked as a starchy staple food. Various parts of *A. altilis* are used to cure many diseases. An endophytic fungus isolated from the fruits of *A. altilis* was identified as *Phoma macrostoma* by molecular means. Pure culture of *P. macrostoma* was inoculated into twenty 1 L-Erlenmeyer flasks, each containing 400 mL potato dextrose broth media, allowed to incubate at room temperature for 10 days and shaken every other day for another 18 days. After four weeks the culture broth and mycelia were extracted with EtOAc separately. The mycelia were further extracted with MeOH. Concentration of the extracts under reduced pressure using a rotary evaporator gave two EtOAc extracts and a MeOH extract. The two EtOAc extracts were combined due to the close similarity of the TLC pattern. Bioassay screening indicated that the combined EtOAc extract was active in brine shrimp lethality assay (IC_{50} 78 ppm), exhibited DPPH radical scavenging activity (IC_{50} 738 ppm) and had phytotoxic activity inhibiting root (IC_{50} 906 ppm) and shoot (IC_{50} 558 ppm) growth. The MeOH extract was active in DPPH radical scavenging assay (IC_{50} 508 ppm). Chromatographic separation of the EtOAc extract furnished spiciferone A (**1**), which was identified by detailed analysis of NMR data. Spiciferone A (**1**) is a polyketide-derived fungal metabolite with a bicyclic unit comprised of a fully subsituted γ–pyrone and a cyclohexenone and reported as a plant growth inhibitor. Ths is the first report of the isolation of *P. macrostoma* as an endophyte from the fruit of *A. altilis* and the isolation of **1** as a secondary metabolite from *P. macrostoma*.

Monitoring exposure of birds to heavy metals and arsenic in Bundala National Park, Sri Lanka: a preliminary study

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Feathers are used as a non-invasive method of monitoring exposure to toxic elements. Bundala National Park (BNP), in the Southern Province of Sri Lanka, a Ramsar site, is a wetland complex used by almost 200 species of resident and migrant wading birds as well as by other birds. Heavy metals and other contaminants accumulate in wetlands through agricultural runoff and atmospheric deposition. Our objectives were to monitor the exposure to heavy metals and arsenic in resident and migratory birds at BNP using feather samples and to determine the patterns of exposure among birds with different dietary habits. Feather samples (n=44) from 12 species (six migrants) were collected from birds captured during the National Bird Ringing Programme during migratory seasons in 2011 – 2013. Feathers were analysed by inductively coupled plasma mass-spectrometry (ICP-MS) for Hg, Cd, Pb and As. The range (mean ± S.E.) of Hg, Cd, Pb and As in tested samples were 0-8.20 (2.02 ± 0.27), 0-1.88 (0.10 ± 0.05), 0-12.63 (2.18 ± 0.45) and 0.01-10.20 (0.94 ± 0.25) mg/kg respectively. The highest mean concentrations of Hg, Pb and As were recorded in three species of migrant waders which were 3.05 mg/kg (± 0.84) of Hg in Tringa totanus (n=10), 4.30 mg/kg (± 1.92) of Pb in Tringa stagnatilis (n=3) and 1.14 mg/kg (± 0.64) of As in Calidris ferruginea (n=4). Both resident passerines tested, Pycnonotus luteolus and Turdoides affinis (n=2 each), showed levels of contaminants that were higher than expected. Hg levels in P. luteolus and T. affinis were 1.20 (± 0.69) and 1.86 (± 1.21) mg/kg respectively. These two omnivorous species are at lower tropic levels than waders and less likely to bioaccumulate metals. This study shows that both migrant and resident birds of varying dietary habits at BNP are exposed to Hg, Cd, Pb and As. The results of this preliminary study indicate that levels of heavy metals and arsenic in the environment are high enough to cause adverse effects in birds. This study also highlights the importance of monitoring the exposure of wildlife to contaminants especially in protected areas as these areas are vital for their conservation.

Structures and properties of naphthoquinones produced by *Monacrosporium ambrosium*, an ectosymbiote of the shot hole borer beetle *Xyleborus fornicatus*

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The fungus, *Monacrosporium ambrosium* (syn. *Fusarium ambrosium*) has a symbiotic association with the shot-hole borer beetle, *Xyleborus fornicatus*, an insect pest that causes serious damage to the tea (*Camellia sinensis* var. *assamica*) plantations in Sri Lanka. Here we report the isolation of six naphthoquinones produced by the fungus *M. ambrosium* and the biological activities of the crude extracts of the fungal culture. *M. ambrosium* was fermented in potato dextrose broth and medium was extracted with ethyl acetate (EtOAc) and the mycelium with EtOAc and methanol (MeOH). Chromatographic separation of the combined two EtOAc extracts (Extract A) afforded six pigmented naphthoquinones, identified as anhydrojavanicin, dihydroanhydrojavanicin, 7-acetonyl-5, 8-dihydroxy-6-methyl-1, 4-naphthoquinone, javanicin, anhydrofusarubin and solaniol. Extracts were screened for antifungal activity, brine shrimp lethality, lettuce seed germination assay and α-amylase inhibitory assay. Furthermore, the antifungal activity was examined against two endophytic fungi, *Pestalotiopsis camelliae* and *Phoma multirostrata* isolated from tea stems as well as three endophytic fungi, *Bipolaris sorokiniana*, *Daldinia eschscholizii* and *Glomerella magna* from *Costus speciosus*, *Phyllanthus acidus* and *Piper betel* respectively against *M. ambrosium*.

Extract A was found to possess several compounds with antifungal activity against *C. cladosporioides*. The shoot and root elongation of lettuce seeds were found to be completely inhibited by the EtOAc extract of culture broth and EtOAc extract of mycelium at 250 and 1000 ppm, respectively. The root elongation was completely inhibited at 2000 ppm of MeOH extract of mycelium while complete inhibition of shoot elongation was observed at 4000 ppm. The extracts were found to be positive in the brine shrimp lethality LD_{50} -702, 1395 and 993 ppm for the EtOAc extract of culture broth, EtOAc extract of mycelium and MeOH extract of mycelium, respectively. None of the extracts showed good activity in the α-amylase inhibitory activity assay. Extract A was found to inhibit the growth of two endophytic fungi *P. camelliae* (100% at 1000 ppm) and *P. multirostrata* (38.1% at 1000 ppm). *M. ambrosium* did not inhibit the growth of *B. sorokiniana*, *D. eschscholtzii* and *G. magna*. These results suggest that *M. ambrosium* produces antifungal naphthoquinones, which selectively inhibit the growth of two endophytic fungi living within tea stems.

Synthesis and characterization of plant based thiophene and 3-hexylthiophene copolymers

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Polythiophene and its derivatives have become more desirable due to their applications in various fields. These applications arise due to their inherent properties, such as optical and electronic conductive properties; as well as thermal and environmental stability. Precursors of polythiophenes are generally obtained from petroleum by-products, which are non-renewable. It has been reported that precursors of polythiophenes and its derivatives are naturally available in different types of *Tagetes* species such as *Tagetes erecta, Tagetes tenuifolia*, etc. A number of thiophene derivatives such as 2, 2':5', 2''-terthienyl (Alpha-T), 5-(3-buten-1-ynyl)-2, 20-bithienyl (BBT), 5-(4-hydroxy-1-butynyl)-2, 20-bithienyl (BBTOH), and 5-(4-acetoxy-1-butynyl)-2, 20-bithienyl (BBTOAc), were found and identified, specifically in the roots of *Tagetes* species. The current study reports the polymerization of the extracted thiophene derivatives from *Tagetes erecta* and 3-hexylthiophene (3HT) to obtain a random copolymer of poly (thiophenes-3-hexylthiophene). The extracted thiophene derivatives were partially purified and characterized. The mixture of plant based thiophenes and commercial 3HT with various weight compositions were selectively polymerized on the direct one-step chemical oxidative free radical polymerization to obtain co-polymers. Structural characterization of the synthetic products was done using Fourier Transformation Infrared, Proton Nuclear Magnetic Resonance, Ultra Violet Visible and X-ray Diffraction techniques. Homopolymers of polythiophene obtained from plant based thiophenes have limited processability of solar cells due to poor solubility in common organic solvents. 'However, a significant progress of the solubility was observed with copolymers having partial contribution of 3HT.

Intercalation of alkaloids of *Cassia auriculata* linn. into h+- and al3+- exchanged montmorillonite clays

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Montmorillonite $[(Na,Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2.nH_2O]$ is a layered aluminosilicate mineral having an expandable interlayer space of 1-2 nm. The inherent net negative charge on outer surface of the layers is counteracted by the presence of exchangeable cations in the interlayer nanospace. Cation-exchanged H^+- and Al^{3+}-montmorillonite (MMT) clays show Lewis and Bronsted acidities and have the potential to trap alkaloids. In this study, the cation-exchanged clays were used to trap alkaloids present in the *Cassia auriculata* Linn. leaf extract; *C. auriculata* is a medicinal plant having anti-diabetic, antioxidant, antimicrobial, anticancer, anthelmintic, anti-inflammatory and analgesic activities. However, it contains hepatotoxic pyrrolizidine alkaloids and their removal may enhance the medicinal value of the plant. Leaf extracts of *C. auriculata* were obtained by successive extraction of dried leaf powder into hexane and methanol using a Soxhlet apparatus. Alkaloids present in the leaf extracts were analyzed qualitatively by TLC and quantitatively by ion-pair formation (IPF) method coupled with UV-Vis spectroscopy. H^+- and Al^{3+}-MMT clays were prepared by stirring purified Na^+-MMT in aqueous solutions of HCl and $AlCl_3$, respectively. Alkaloid intercalated H^+- and Al^{3+}-MMT clay composites were prepared by stirring suspensions of H^+- and Al^{3+}-MMT clays in solutions of *C. auriculata* leaf methanol extract in 50% $MeOH/CH_2Cl_2$. The amounts of alkaloids present in the supernatant before and after the intercalation were determined using the coloured ion-pair complexes formed between the protonated alkaloids and methyl orange at an optimum pH of 4.4. UV-Vis measurements of the ion-pair complexes were carried out at 428 nm using brucine as the standard alkaloid. All the clays and their alkaloid composites were characterized using X-ray diffraction (XRD) and Fourier-Transform Infrared (FT-IR) spectroscopy. The intercalation of alkaloids in the MMT clay composites was further confirmed by releasing of the trapped alkaloids in NaOH solution, which was quantified by IPF/UV-Vis method. The results indicated intercalation of 97% and 98% of *C. auriculata* alkaloids of methanolic leaf extract into H^+- and Al^{3+}-MMT clays, respectively. When the alkaloid-intercalated clay composites were stirred in 0.5 M NaOH, slow releasing of the trapped alkaloids was observed, reaching a maximum of 59% release (after 3 h) from H^+-MMT and 50% release (after 4 h) from Al^{3+}-MMT clay composites. It can be concluded that the alkaloids present in the leaves of *Cassia auriculata* can be successfully intercalated into cation-exchanged MMT clays and the intercalated alkaloids can be released slowly upon alkali treatment.

Intercalation of squalene into h+- and al3+-exchanged montmorillonite clays and releasing of squalene at simulated gastric conditions

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Squalene ($C_{30}H_{50}$) is a triterpene found abundantly in shark liver oil, in reasonable amounts in amaranth oil and olive oil, and to a lesser extent in other vegetable oils such as corn oil, sunflower oil and soybean oil and in microorganisms. Although squalene (SQ) has various beneficial effects including anticancer, antioxidant and anti-inflammatory properties, its use as a therapeutic drug is limited due to its low bioavailability owing to its lipophilic nature. Incorporation of squalene into the hydrophobic cavity of β-cyclodextrin (β-CD) can yield a composite with a hydrophilic outer coat which can then be intercalated into montmorillonite (MMT) clay's hydrophilic interlayer nanospace. MMT clays are layered aluminosilicates with expandable interlayer 1-2 nm space, having exchangeable cations between the layers. In this study, intercalation of squalene into cation-exchanged H^+- and Al^{3+}-MMT (M^{n+}-MMT) with and without the assistance of β-CD, and subsequent releasing of squalene from the clay composites at simulated gastric conditions (pH 1.2, 37 ºC) were investigated. The cation-exchanged H^+- and Al^{3+}-MMT were prepared by stirring purified Na^+-MMT clay with aqueous HCl and $AlCl_3$, respectively. M^{n+}-MMT-β-CD-SQ composites were prepared by mixing SQ, β-CD and M^{n+}-MMT according to three different procedures that differ from one another in the order of mixing the components. All the M^{n+}-MMT clays and the M^{n+}-MMT-β-CD-SQ clay composites were characterized by FTIR and X-ray diffraction techniques. The most effective method was mixing of SQ, β-CD and M^{n+}-MMT together, which afforded more than 80% incorporation of SQ. In the absence of β-CD, SQ loading into Al^{3+}-MMT decreased to 66% while that into H^+-MMT remained almost the same. Releasing studies conducted at simulated gastric conditions with time revealed gradual releasing of SQ, reaching 97% and 100% release from Al^{3+}-MMT-β-CD-SQ and H^+-MMT-CD-SQ composites, respectively, after 6 h. Squalene-intercalation and -release were quantified using gas chromatography. In conclusion, SQ can be intercalated into cation-exchanged MMT clays and SQ can be slowly released from the clay composites at simulated gastric conditions.

A preliminary taxonomic survey of leafy liverworts from some selected localities of Sri Lanka

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Bryophytes with a dominant haploid generation and a dependent sporophyte in their life cycle are the first group of plants that successfully colonized the terrestrial habitats. Bryophytes include three distinct groups based on the morphological heterogeneity of the gametophyte and these are currently included in three distinct phyla; Marchantiophyta (liverworts), Bryophyta (mosses) and Anthocerotophyta (hornworts). Sri Lankan leafy liverworts are very poorly researched with only a very few collections done by past foreign scientists. There are no proper taxonomic studies conducted on this group. Based on the most recent, revised checklist of Sri Lankan liverworts and hornworts, there are 25 families, 64 genera and 286 species of leafy liverworts. Therefore the objective of the present study was to carry out a preliminary taxonomic survey of the leafy liverworts present in Sri Lanka to initiate further taxonomic and systematic studies on this important plant group.

Fresh specimens of leafy liverworts were collected from some selected localities including Dothalugala, Loolcondera, Hakgala, Sinharaja Forest Reserve, Trincomalee, Anuradhapura, Dambulla, Kantale, and Hortain Plains. The collected specimens were thoroughly surveyed for their macro and micro morphological and anatomical characteristics. Using the available keys, monographs and other taxonomic literature, the collected specimens were identified to generic and/or to species level. Taxonomic descriptions, illustrations and taxonomic keys were prepared for all the species identified.

The present study identified a total of 14 families, 26 genera and 46 species of leafy liverworts with 3 new records in Sri Lanka; *Heteroscyphus planus* (Mitt.) Schiffn. (Lophocoleaceae), *Drepanolejeunea tricornua* Herzog. (Lejeuneaceae) and *Cereatolejeunea cornuta* (Lindenb.) Steph. (Lejeuneaceae). Leafy liverworts are highly diverse in their leaf arrangement, leaf lobe and lobules, under-leaves and also by various anatomical characters. Majority of the leafy liverworts encountered during the present study were epiphyllous and epiphytic. Identification of the taxa of leafy liverworts and explorations of their habitat diversity will emphasize the importance of conservation of these plants. Further field explorations should be carried out throughout the country to collect samples of leafy liverworts for detailed morphological and molecular studies.

Abundance and status of migratory water birds on Mandaitivu and adjacent areas in Jaffna, Sri Lanka

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Migratory water birds are regularly present in the Jaffna peninsula from September to April. Previous studies on the status of migratory bird species in Jaffna are virtually lacking, mostly due to the insecurity of the area for three decades. As some of these species are rare and endangered, proper scientific studies are essential for their conservation. The objective of the present study was to evaluate the status of migratory water bird species on Mandaitivu and adjacent areas (i.e. Allaipiddy and Mankumban) in Jaffna. The study was carried out during three consecutive migratory seasons (September 2013 - April 2014; September 2014 - April 2015; September 2015 - April 2016). We used point counts for assessing abundance of birds. Each counting station was separated from the next by at least 250 m, to prevent double-counting. Binoculars (8 × 40) and a spotting scope (25 × 50) were used to observe birds. Peak counting hours were from 0630-1000 h and 1530-1800 h. Each count lasted for about 20 minutes. Each site was visited multiple times throughout the study period to allow for replication.

Thirty two migratory water bird species in seven families were recorded from Mandaitivu, including one very rare and 10 uncommon/rare winter migrants. It is significant that the Greater Flamingo (*Phoenicopterus roseus*), an uncommon winter migrant, had the highest individual count (612) of any migratory bird species on Mandaitivu. From Allaipiddy, 21 migratory water bird species in five families, including one very rare and five uncommon/rare winter migrants, were recorded. The Bar-tailed Godwit (*Limosa lapponica*), a rare winter migrant, had the highest count of any migratory bird (1053) in the area. Eighteen migratory waterbird species in five families, including one very rare and four uncommon/rare winter migrants, were recorded from Mankumban. The Eurasian Wigeon (*Anas penelope*) and Brown-headed Gull (*Chroicocephalus brunnicephalus*) had the highest individual counts (4399 and 2102 respectively) of any migratory bird species in Mankumban. Of these, the Wigeon has been recorded very rarely until a few decades ago. Of the three sites, Mandaitivu showed the highest migratory water bird diversity with a Shannon Index of 2.48, while Mankumban ranked second with a Shannon Index of 1.25. Allaipiddy showed the lowest diversity (Shannon Index 0.971). Given the very high relative abundance of rare or uncommon migratory water bird species, we recommend that the wetlands in these areas be declared as internationally important waterfowl habitats.

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Anti-candidal activity of two plant extracts

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Candida species which cause human infections are resistant to some antifungal drugs used today. Therefore requirement of new anticandidal agents has increased. Medicinal plants that were used in traditional medicine were found to be multipurpose drugs. Hence study of anticandidal activity of the medicinal plants place an important role in discovering new anticandidal agents. *Flueggea leucopyrus* is commonly used for cancer treatment in traditional medical systems. *Osbekia octandra* is also important in traditional medical systems as its plant parts are used to treat various illnesses, one of which is diabetes. Therefore the aim of this study was to investigate the anticandidal activity of *Flueggea leucopyrus* and *Osbeki*a *octandra* plants.

Ethanolic extracts were prepared by adding 5ml of ethanol for 1g of ground leaves of each plant separately. These extracts were used to investigate the anticandidal activity. The agar well diffusion assay was performed on isolates of *Candida albicans, Candida tropicalis* (ATCC13803), *Candida glabarata* (ATCC90030), *Candida parapsilosis* (ATCC22019) and *Candida krusei* (ATCC6258).

Minimum inhibitory concentration (MIC) values of crude extracts that were made using the rotary evaporator were determined by agar dilution assay for the above Candida species.

Results of the agar well diffusion assay of *Flueggea leucopyrus* were 3.33mm, 4.34mm, 1.67mm, 4mm, 2.34mm and results of *Osbekia octandra* were 8.34mm, 4.33mm, 3.34mm, 8.67mm, 5mm for *Candida albicans*, Candida parapsilosis (ATCC22019), Candida tropicalis (ATCC13803), *Candida glabarata* (ATCC90030) and *Candida krusei* (ATCC6258) consecutively.

MICs of *Flueggea leucopyrus* were 32mg/l for *Candida parapsilosis* (ATCC22019). *Candida tropicalis* (ATCC13803), *Candida glabarata* (ATCC90030), Candida krusei (ATCC6258) and the clinical isolates of *Candida albicans* showed MIC value of 64mg/l.

MICs of *Osbekia octandra* extracts against *Candida parapsilosis* (ATCC22019), *Candida glabarata* (ATCC90030), *Candida krusei* (ATCC6258) and the clinical isolates of *Candida albicans* found to be 32mg/l. *Candida tropicalis* (ATCC13803) showed a MIC value of 64mg/l.

The result confirmed that the leaves of *Flueggea leucopyrus* and *Osbekia octandra* contain anticandidal activity.

Evaluation of antioxidant properties and alpha-amylase inhibitory activities of some medicinal plants

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Antioxidant compounds are claimed to have an impact in disease prevention. The objective of this study was to evaluate the total phenolics content, antioxidant and alpha-amylase inhibitory activities of the leaf extracts of *Averrhoa bilimbi* (AB), *Argyreia populifolia* (AP), *Costus speciosus* (CS), *Desmodium gangeticum* (DG), *Solanum nigrum* (SN), *Spondias dulcis* (SD), *Wattakaka volubilis* (WV) and *Ziziphus rugosa* (ZR) which are consumed in traditional and Ayurvedic medicine in Sri Lanka.

The dried plant materials were sequentially extracted with n-hexane, ethyl acetate and methanol. The total phenolics content (TPC) was quantified in the ethyl acetate extracts using the Folin-Ciocaltaeu method and values were expressed as miligrams gallic acid equivalents per gram (mg GAE/g). Oxygen Radical Absorbance Capacity (ORAC) and Ferric ion Reducing Antioxidant Power (FRAP) was evaluated using a trolox standard curve, and both values were expressed as μmol Trolox Equivalents per gram (μmol TE/g). Activity of α-amylase inhibition was assessed using 3, 5-dinitrosalicylic acid reagent and values were expressed as IC_{50} (ppm). TPC values were highest in SD (12.5 ±0.54 mg GAE/g) while SN had the lowest value (1.33 ±0.01 mg GAE/g). ORAC values varied between 404.8 ± 32.80 and 2613 ±191.3 μmol TE/g and decreased in the order of SD > DG > AP > WV > SN > ZR > AB > CS. FRAP values were highest in SD (521 ± 25.0 μmol TE/g) while the lowest was reported for SN (66.9 ± 1.45 μ mol TE/g). Statistical analysis was conducted using SPSS version 20 (USA). FRAP values were linearly correlated to TPC values with an R^2 of 0.936. However, there was no significant correlation between TPC and ORAC values (R^2=0.392). SD had the highest values for TPC, ORAC and FRAP assays. The IC_{50} for α-amylase inhibitory activities was above 1000 ppm for all extracts. It may be concluded that some of these herbs are potent antioxidants and contain a considerable amount of phenolic compounds. Hence, further evaluation of their therapeutic potential *may* be carried out through activity fractionation.

Fabrication of seed assisted Cds and properties

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CdS is an imperative member of the II−VI group with comprehensive applications as gas sensors, photovoltaics, photodetectors and photochemistry, owing to its direct band gap, low work-function, high electronic mobility and excellent thermal and chemical stability. In this study, a novel method of fabricating chemical bath deposited CdS (CBD-CdS) by using electrodeposited CdS (ED-CdS) as a seed layer is reported. Thin layer of CdS was electrochemically deposited on fluorine doped tin oxide (FTO) glasses by three electrode cathodic electrodeposition in an aqueous solution of 0.05 mol dm^{-3} cadmium chloride, 0.05 mol dm^{-3} sodium thiosulfate at -600 mV against the Ag/AgCl electrode, at a bath temperature of 60 °C and a pH between 1-2. CBD process on ED-CdS was carried out using, 0.001 mol dm^{-3} cadmium sulphate, 0.002 mol dm^{-3} thiourea and 1.1 ml of ammonia solution and the deposition process was carried out at a bath temperature of 80 °C for one hour. Later, the fabricated films were air annealed at 200 °C for 1 hour. The crystallographic phase of the fabricated seed assisted CdS films (ED/CBD-CdS) was determined to be hexagonal by GIXRD analysis. The ED/CBD-CdS films were found to display better compactness, uniformity and an enhanced effective surface area compared to CBD-CdS. The fabricated films of ED/CBD-CdS show high phtoelectrochemical efficiency than CBD-CdS thin films. Carrier concentration (6.62×10^{17} cm^{-3}) and flat band potential (-907.60 mV Vs. Ag/AgCl) values calculated for ED/CBD-CdS systems using Mott-Schottky measurements were found to be significantly greater compared to CBD-CdS films. Furthermore, the band gap and its disorder estimated using UV-Vis spectroscopic measurements also revealed better optical properties for ED/CBD-CdS. Hence, seed assisted CdS can be concluded to show better electrical and optical properties compared to conventional CBD-CdS films.

Abstract No: 270   *Natural Sciences*

TX-100 assisted CBD-Cds thin films

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Among various deposition methods of CdS thin films, chemical bath deposition (CBD) stands out owing to its simplicity and low-cost of fabrication to produce high quality thin films. Triton X 100 (TX-100) is a nonionic surfactant which is widely used as a detergent. In this work CdS thin films were fabricated using the CBD method in the presence of TX-100 (CBD/TX100-CdS). The performances of the fabricated samples were then compared with films deposited without TX-100, using conventional CBD method (CBD-CdS). CBD/TX100-CdS was deposited on thoroughly cleaned fluorine-doped tin oxide (FTO) coated conducting glass substrates using 0.001 M $CdSO_4$, 0.002 M $CS(NH_2)_2$, 1.1 ml of NH_4OH solution and 0.647 mg cm^{-3} of TX-100 in a reaction vessel for one hour. For CBD-CdS, same steps were followed with the use of same chemicals except TX-100. Both TX-100 treated and untreated CdS thin films were fabricated under bath temperatures of 40, 60 and 80 ˚C. Later, all the samples were air annealed at 300 ˚C for one hour. The fabricated samples were characterized using GIXRD, SEM, UV-visible spectroscopy, Mott-Schottky and photo electrochemical (PEC) cell. GIXRD results reveal that the deposited films are hexagonal in phase. Transmittance in the range 300-800 nm was found to be higher for CBD/TX100-CdS compared to CBD-CdS samples. The SEM images indicate all the CBD/TX100-CdS has smaller cluster sizes compared to CBD-CdS samples, which leads to higher band gap values obtained from UV-visible spectroscopy for CBD/TX100-CdS. PEC cell measurements yield that both I_{SC} and V_{OC} values for CBD/TX100-CdS are higher compared to CBD-CdS, while CBD/TX100-CdS fabricated at 60 ˚C bath shows the best $I_{SC} \times V_{OC}$ product. These impressive I_{SC} values observed for CBD/TX100-CdS samples can be due to higher surface roughness of CBD/TX100-CdS, as a result of its smaller cluster sizes. Additionally, the flat band potential calculations from Mott-Schottky measurements also reveal that the deposited CBD/TX100-CdS films have higher flat band potential compared to CBD-CdS. All these results confirm that the optical and electrical properties of the CdS thin films can be effectively improved by the introduction of TX-100 to the deposition medium.

Abstract No: 274 (Poster)   *Natural Sciences*

Comparison of tiger beetle (*Coleoptera:Cicindelidae*) diversity in four protected areas in different climatic zones of Sri Lanka

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Tiger beetles are highly predacious carabids with over 2,500 described species worldwide. In terms of density and richness, Sri Lanka is regarded as a global hot spot for tiger beetles. According to literature 56 tiger beetle species have been recorded of which 35 are endemic to country. During the period 2014-2016 tiger beetles were surveyed in four protected areas in the country. This paper attempts to compare tiger beetle richness in Sinharaja Rain Forest (Wet Zone), Dhaiyagala Sanctuary (Intermediate Zone), Chundikulum Sanctuary (Dry Zone) and Bundhala National Park (Arid Zone). Each location was visited twice on days that were not overcast and sampling was done using visual encounter surveys. At each sampling locality after detecting tiger beetles; population counts were obtained by walking along transects ranging from 100 m to 300 m. The variable lengths of transects reflected the physical obstacles of different localities. The survey was conducted in primary and secondary forests, foot paths, stream edges, forest gaps (Sinharaja), scrub forests, lagoons, beaches, sand dunes (Chundikulum, Bundhala), thick and secondary forest patches, foot paths, scrubs, tank edges, paddy and corn cultivations (Dhaiyagala). Specimens collected were subsequently identified to the species level using available keys. PAST 3.12 statistical software was used to calculate the diversity indices. The highest species richness was recorded from Dhaiyagala Sanctuary (8 species) and *Oligoma lacunosa* was the dominant species. *Calomera angulata* was the most abundant species in Bundhala National Park and Chundikulum Sanctuary. Surprisingly, the lowest number of species was recorded from Sinharaja Rain Forest and *Calochora lacrymans* was the most commonly occurring species. None of the species was found to be common to all four protected areas. In terms of Shannon index (H) Dhaiyagala (1.24) had the highest diversity and lowest H values was recorded from Sinharaja. *Calochora lacrymans* and *Ifasina waterhousei* recorded from Sinharaja are endemic. An extremely rare endemic species *Jansenia laeticolor* was recorded from Bundhala after 108 tearsand no other specimens were sighted in subsequent visits. The endemic species *Ifasina henryi*, *Calochora lacrymans* and *Ancyclia ceylonensis* were also observed from Dhaiyagala. In terms of tiger beetle conservation, Dhaiyagala can be considered as a critical location which included more open forest gaps and micro habitats compared to other three protected areas. There could be other causes such as evolutionary and physiological and climatic factors that favor tiger beetle species accumulation to specific habitats. The longer term implications of climate change impacts have to be taken into account in strategies for conservation of tiger beetles of Sri Lanka although the current climate projections for the wet, intermediate, dry and arid zones have shown high uncertainty with regard to precipitation changes, while a trend for warming and occurrence of extreme events appears to continue.

A comparative study on ED-Cds and CBD-Cds thin films

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Among various deposition methods of CdS, chemical bath deposition (CBD) and electrochemical deposition (ED) standout due its simplicity, low cost along with uniformity of the fabricated samples. In this work CdS thin films are fabricated using CBD (CBD-CdS) and ED (ED-CdS) methods and compared using XRD, SEM, UV-visible spectroscopy and photoelectrochemical cell (PEC) measurements. All samples were deposited on thoroughly cleaned fluorine doped tin oxide (FTO) glasses. CBD-CdS was fabricated using, 0.001 M $CdSO_4$, 0.002 M $CS(NH_2)_2$ and 1.1 ml of NH_4OH at a bath temperature of 80 °C for one hour. ED-CdS was deposited by three electrode cathodic electrodeposition in an aqueous solution of 0.05 M $CdCl_2$, 0.05 M $Na_2S_2O_3$ at -600 mV against the Ag/AgCl electrode, at a bath temperature of 60 °C and a pH between1-2. All fabricated films were air annealed at 200 °C for 1 hour. The XRD analysis shows that the fabricated ED-CdS and CBD-CdS are predominantly hexagonal. The SEM images of the ED-CdS samples indicate that the surfaces of the fabricated films containing spherical features with various sizes. ED-CdS indicate more uniform coagulates compared to that of CBD-CdS. Hence, it is expected that the electrochemical deposition gives better packing, higher uniformity and better contact with the FTO, resulting in higher I_{SC} for ED-CdS. The flat band potential value calculated form the Mott-Schottky plot was found to be -683 mV vs. Ag/AgCl for the ED-CdS and -533 mV vs. Ag/AgCl for the CBD-CdS, suggesting the existence of different electron affinity levels of CdS depending on the deposition method. The average transmittance of fabricated CBD-CdS and ED-CdS films were found to be 75% and 51% respectively. It can be concluded that the opto-electrical properties of CdS thin films are dependent on deposition method and ED-CdS show superior electrical properties compared to CBD-CdS.

Antimicrobial and antioxidant activities of *Plectranthus zeylanicus* Benth

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Plectranthus zeylanicus Benth. (Iruveriya) is a perennial herb extensively used in traditional medicine in Sri Lanka for treating fever, asthma, dysentery, diarrhoea, chronic liver diseases etc. Despite the wide array of applications in traditional and folk medicine, the bioactivities and pharmacological features of this plant are hardly explored. Thus the present investigation is undertaken to evaluate the antimicrobial and antioxidant properties of *P. zeylanicus* and to identify the bioactive metabolites and thereby to rationalize its ethnobotanical use.

The plant materials were collected from Gampaha district- Sri Lanka, authenticated and subjected to sequential extraction with hexane, dichloromethane, ethylacetate and methanol. The antimicrobial activity of the plant extracts were determined by disc diffusion and broth microdilution methods against both Gram positive and Gram negative bacteria, *Enterococcus faecalis, Staphylococcus aureus*, *Staphylococcus saprophyticus* and *Salmonella* Typhi. The antioxidant activity of the extracts was evaluated by 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay. Hexane, dichloromethane, and methanol extracts of *P. zeylanicus* have displayed antibacterial activity at 1000 µg/mL for all four microorganisms while the ethylacetate extract was active against only *S. aureus*, *S. saprophyticus* and *S.* Typhi. Out of these extracts, hexane extract was found to be the most potent with MIC values of 31.25 µg/mL against *S. saprophyticus* and *S. aureus*, 62.5 µg/mL against *E. faecalis* and 500 µg/mL against *S.* Typhi. Dichloromethane extract has also displayed MIC values in the range of 31.25-500 µg/mL. Interestingly, our previous studies have also revealed that both hexane and dichloromethane extracts could exhibit strong anti-inflammatory activities by inhibiting 5-lipoxygenase enzyme in cell based and cell-free assays. This would further suggest for possible correlation between anti-inflammatory and antimicrobial properties in these extracts. However, none of the extracts have displayed a significant antioxidant activity and the EC_{50} values were much higher than the positive control, ascorbic acid (EC_{50}= 14.31µg/mL). Thus it is possible to speculate that the bioactive metabolites in the promising extracts are incapable of scavenging the free radicals, however this has to be confirmed by further experiments. Activity guided fractionation is in progress to isolate the bioactive secondary metabolites, which could direct towards the discovery of antibiotics of plant origin.

Chemistry and bioactivity of secondary metabolites from *Pestalotiopsis microspora*, an endophytic fungus from *Manilkara zapota*

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Endophytes are now considered as an outstanding source of bioactive compounds. In a continuation of our studies towards the search for bioactive compounds from Sri Lankan flora we investigated the secondary metabolites of the endophytic fungus *Pestalotiopsis microspora* isolated from the fruits of *Manilkara zapota* of the family Sapotaceae. Fruits of the *M. zapota* are edible and popular in Sri Lanka. We have previously reported the isolation and identification of pestalotin (1) and hydroxypestalotin (2) from the endophytic fungus *P. microspora* from the same origin. Here we report the isolation and identification of three more secondary metabolites pithaloide B (3), pithaloide D (4) and a new pithaloide having an additional lactone ring (5).

An endophytic fungus isolated from the fruits of *M. zapota* was identified as *P. microspora* by molecular means. Large scale culturing was carried out by inoculating pure culture of the fungus to PDB medium, which were allowed to stand at room temperature for 10 days, and then incubated while shaking every other day on a laboratory shaker for another 20 days. The medium was filtered after one month and the filtrate was extracted with ethyl acetate (EtOAc). Residual mycelium was extracted with EtOAc using sonicator. TLC analysis indicated the similarity of the two EtOAc extracts. Hence the two extracts were combined and screened for antioxidant activity (DPPH assay), α-amylase inhibition activity, antifungal activity against *Cladosporium cladosporioides*, phytotoxicity against *Lactuca sativa* seed germination, brine-shrimp toxicity against *Artemia salina* and anti-candidal activity against five candidal species. Chromatographic separation of EtOAc extract furnished compounds 3–5 with yellow fluorescence together with 1 and 2. Bioactivity studies of the isolates are in progress. This is the first report of the isolation of *P. microspora* from *M. zapota* as well as pitholides from *P. microspora*.

Ethnobotanical study on medicinal plants used as anti-inflammatory therapeutics among the inhabitants of Gampaha district- Sri Lanka

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Plants and plant based products play a major role in traditional medicine in Sri Lanka. A large number of plant species are extensively used to alleviate the pathological conditions caused by inflammation. However, an in-depth study has not been pursued yet in Sri Lanka to assess the significance and contribution of medicinal plants/herbal therapeutics for inflammatory conditions. Thus as a part of our ethnomedical inventory work in different regions in the country, the present study was carried out in Gampaha district which is famous for several pedigrees of traditional physicians.

The field study was conducted with 458 participants covering all 13 divisional secretariats in Gampaha district using semi-structured interviews. Ethnobotanical data were analyzed using relative frequency of citation (RFC) and family importance value (FIV). Demographic characteristics of the participants were also recorded. Out of the total participants, 232 (50.7%) claimed the usage of medicinal plants for the treatment of inflammatory conditions such as fever, cough, asthma, rheumatic arthritis etc. A total of 43 medicinal plants belonging to 28 plant families were mentioned, out of which *Coriandrum sativum* was the most cited species followed by *Coscinium fenestratum* and *Adhatoda vasica*. *Fabaceae* was the most cited plant family while family importance value was highest in *Apiaceae.* The most frequently used plant part was leaves (34.1%) and the most common preparation method was infusion. 46.16% have mentioned the reason for their choice as their belief on low adverse effects associated with the herbal formulations. Among the non-users of the herbal products, majority has claimed that the difficulty in preparation (24.69%) and collection of plant materials (22.22%) has hindered the usage, while considerable number of people have mentioned that they do not have any faith as the effectiveness is not scientifically proven. Interestingly 71.43% of the non-users mentioned that they would shift to herbal products if systematic scientific studies are conducted.

The present study has led to the identification of medicinal plants widely utilized for the treatment of inflammatory conditions. The effectiveness and safety of these plants will be assessed by phytochemical and pharmacological studies in the follow-up studies.

Fumigaclavine C and monomethylsulochrin from an endophytic fungus *Aspergillus fumigatus* from *Solanum insanum* fruits

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The objective of this investigation is to study the chemistry and bioactivity of secondary metabolites produced by endophytic fungi from fruits of *Solanum insanum* (elabatu). An endophytic fungus isolated from the fruits of *S. insanum* was identified as *Aspergillus fumigatus* of the family *Trichocomaceae,* by molecular methods using Internal Transcribed Spacer (ITS) region 1 and 4 of the rDNA gene. *A. fumigatus* was mass cultivated on potato dextrose broth (PDB) medium in 1 L Erlenmeyer flasks containing 400 mL of the medium (24 L) were allowed to stand at room temperature for 10 days, and then incubated while shaking (95 rpm) every other day for another 18 days on laboratory shaker. The culture medium was filtered and the filtrate was extracted with EtOAc. The residual mycelium was crushed and extracted with EtOAc using a sonicator. Based on thin layer chromatography (TLC) analysis the two EtOAc extracts were combined. The extract was subjected to preliminary screening for antifungal activity against *Cladosporium cladosporiodes* with TLC bioautography method, radical scavenging activity against DPPH, brine shrimp lethality assay against *Artemia salina* and α-amylase inhibition assays. Chromatographic separation of the extract over silica gel, Sephadex LH-20 and PTLC furnished two UV active compounds, which were identified as fumigaclavine C and monomethylsulochrin by detail analysis of NMR data and comparison with reported NMR data. Strong antifungal activity of fumgaclavin C was observed against *C. cladosporioides*. Bioinhibitory effect of *A. fumigatus* was observed against the endophytic fungi *Xylaria berteri* and *Colletotrichum siamense* isolated from *Piper nigrum*. Fumigaclavine C belongs to an ergoline group of alkaloids. Monomethylsulochrin is a benzophenone derivative, which could be biosynthesized via an anthraquinone through polyketide pathway. Endophytic strains of *A. fumigatus* have been isolated from several plant species and the production of both compounds by the fungi has been reported. This is the first report of the isolation of endophytic fungus *A. fumigatus* from *Solanum* species.

Search for novel therapeutics for gout: a preliminary screening for xanthine oxidase inhibitors from some medicinal plants

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Gout is a metabolic disorder associated with the accumulation of uric acid in the joints, tendons and surrounding tissues. The enzyme xanthine oxidase catalyses the oxidation of hypoxanthine to xanthine and then to uric acid which is the final product of the catabolism of purine nucleotides. Thus one of the therapeutic approaches to treat gout involves the use of xanthine oxidase inhibitors. Allopurinol and febuxostat are the only xanthine oxidase inhibitors currently employed under clinical applications, although several side effects are associated with their use. Thus the search for novel xanthine oxidase inhibitors with high therapeutic potency and lesser side effects from nature is desired for the treatment of gout and other diseases associated with the xanthine oxidase activity. So far no study has been reported on the xanthine oxidase inhibitory potential in medicinal plants in Sri Lanka. Thus the present investigation has been undertaken to screen several medicinal plants that have been widely employed in traditional medicine to treat gout and related inflammatory disorders.

Hexane, dichloromethane, ethyl acetate and methanol extracts of whole plants of *Apium graveolens* (asamodagam) and *Leucas zeylanica* (gatathumba), rind of *Citrus sinensis* (panidodam) were tested *in vitro*, at 50 µg/mL concentrations initially for their xanthine oxidase inhibitory potential. Out of the tested plant extracts only dichloromethane extract of *L. zeylanica* was active at 50 µg/mL. Therefore, the dose-dependent inhibition profile of dichloromethane extract of *L. zeylanica* was further evaluated by estimating the IC_{50} value. The IC_{50} value of the above extract was found to be 47.47 µg/mL which is quite comparable with that of the positive control, allopurinol ($IC_{50} = 16.77$ µg/mL). In addition, the antioxidant activity of this promising extract was determined by 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay. However, the antioxidant activity of this extract was low ($EC_{50} = 208.4$ µg/mL) when comapred with the positive control, ascorbic acid ($EC_{50} = 14.31$µg/mL).

The study has revealed the xanthine oxidase inhibitory activity in *L. zeylanica* and this is the first time that Sri Lankan plant species was reported as a potential source of natural xanthine oxidase inhibitor. Further investigations are in progress to develop it into a successful herbal drug to treat gout and other xanthine oxidase related disorders.

PAPER NOT PRESENTED

Cocktail effect of Profenophos and Abamectin used in paddy cultivation on Asian common toad (*Duttaphrynus melanostictus*)

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Inappropriate use of pesticides causes many harmful effects to humans and other non-target organisms. Mixing two or more chemicals into a spraying tank is a common practice among many farmers in Sri Lanka. This study determined the lone and cocktail effect of two commonly used agrochemicals, Profenophos and Abamectin on the Asian common toad under laboratory conditions. First, five days post-hatch tadpoles were exposed to two pesticides to determine 48 hr lethal concentrations (LC_{50}). Then, a chronic exposure to a series of ecologically relevant concentrations (Profenophos: 0.125, 0.25, 0.5, 1.0, 2.0 ppm Abamectin: 0.01, 0.02, 0.03, 0.04, 0.05 ppm) and a mixture of the two concentrations was carried out. Control was set up using de-chlorinated tap water. Survival, behavior and development of malformations were observed daily until metamorphosis. Growth measurements were taken in tadpoles at 15 days, 30 days post-hatch and metamorphs. Low LC_{50} value of 3.78 ppm for Profenophos and extremely low value of 0.12 ppm for Abamectin were recorded. This indicates Abamectin was highly toxic *D. melanostictus* than Profenophos. Chronic exposure to ecological relevant doses had greatly reduced the survival of tadpoles in Profenosfos (Chi square test, $\chi^2 = 133.8$, $p = 0.001$), Abamectin ($\chi^2 = 105.5$, $p = 0.001$) and the cocktail ($\chi^2 = 137.5$, $p = 0.001$). All the exposures caused reduction in growth parameters: snout vent length (SVL) and body weight. A significant reduction in SVL and weight in 15 days post-hatch tadpoles was observed (one way ANOVA, $p = 0.001$). Moreover, pesticide exposed tadpoles took a longer time to metamorphose and showed abnormalities in movement. Exposed tadpoles also developed malformations. Profenophos caused scoliosis and kyphosis, while Abamectin caused edema and the cocktail exposed tadpoles developed both scoliosis and edema. The effects of the cocktail exposure on survival, growth and development of malformations were higher than the individual effects. Relatively few studies have been conducted to determine the cocktail effects of pesticides on amphibians but such exposures are common scenario for larval amphibians in nature as many farmers mix and spray pesticides. The importance of educating farmers about proper usage of pesticides is highlighted here.

Graphene as an anticorrosion coating layer

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Graphene (Gr), the recently discovered allotrope of carbon, has unique properties principally attributed to its 2D hexagonal lattice structure. A single atomic layer of graphene exhibits excellent anticorrosive properties. This anticorrosive property of graphene can be explained by a combination of three processes. First, graphene coatings can make the path of permeating water more tortuous. Second, pristine graphene is impermeable to water. Third, the coatings act as an excellent barrier to water, oxygen and other corrosive materials.

In this study, corrosion of Iron was measured with a coating of Graphene using electrochemical methods. Graphene was prepared from natural graphite (30 μm) through Modified Hummers' method. Selected graphene samples were characterized by Infrared Spectroscopy (IR), X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM).Then it was mixed with Carboxymethyl Cellulose (CMC) in different ratios. Then, those samples were dissolved in the same amount of water to prepare a series of samples for coating. Top surface of the iron were coated by spraying at $250C^0$ to act as the working electrode. The corrosion rate was examined by electrochemical impendence spectroscopic (EIS) measurements and Tafel slope analysis. Both of the result shows that corrosion inhibition efficiency of the coated samples were 30.52 % and 39.26 % respectively in Coated mixture of Graphene with CMC at 3: 1 ratio.

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Screening of antidiabetic and antioxidant activity of edible greens

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Diabetes mellitus is a group of metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The diabetic population is on the rise and is predicted to increase up to the 300 million by the year 2025. Inhibiting the activity of alpha amylase enzyme which is responsible for the breakdown of starch to more simple sugars is one effective method to control diabetes. At present inhibitor drugs used have reported to cause many side effects. Hence searching for new drugs with antidiabetic activity and reduced diabetic complications such as oxidative stress is very important.

In this study we screened greens which are uncommon in the urban areas along with four commonly used greens: *viz. Ipomoea aquatic (*Kankung) *Centella asiatica (*Gotukola) *Murraya koenigii* (Karapincha) and *Alternanthera sessilis* (Mukunuwenna) for their antioxidant and anti-diabetic activity.

Nine of the total leaf extracts were assayed using 3-5,dinitro salicylic acid method for α- amylase inhibitory activity and the leaf extract of *Olax zeylanica* (Maella) showed an IC_{50} of 120.22 ±2.03 µg/mL. All fifteen extracts showed antioxidant activity as evaluated by the DPPH scavenging activity. The extract of *Cotus speciosus* (Thebu) showed an IC_{50} of 4.63 ± 0.13µg/mL with 6 plant extracts exhibiting IC_{50} below 50 µg/ml. The total phenolic content (TPC) measured using Folin-ciocalteu reagent was highest in *Murraya koenigii* (Karapincha) with 137.39 ± 1.35 Gallic acid equivalents (mg) per gram of extract. No direct correlation was observed between the TPC and the DPPH scavenging activity. The reducing power was evident in all fifteen extracts and the best was in the extract of *Murraya koenigii* (Karapincha). Our results show that the greens used in the sub-burn areas have comparatively better antioxidant and antidiabetic activity in comparison to the commonly used greens. Our results show that these leafy extracts could be used to reduce oxidative stress and also show antidiabatic activity.

Resource partitioning in bird faunas of forest and agricultural ecosystems

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Studies on niche dynamics or resource partitioning are useful in the conservation of bird species. The present study was carried out to study how birds partitioned space according to the foraging guilds in a relatively undisturbed secondary forest at Upper Hantana and a nearby agricultural land. Data collection was done from January to August 2015. Twenty sampling points were selected in each habitat using systematic random sampling method. Each sampling point (separated from the next by a minimum distance of about 250m to avoid double counting) was observed twice a week for 15 weeks. Peak observation hours were from 0600h-0900h and 1500h-1800h. Height (m) to the branch or trunk of a particular tree (consisting of foraging sites as well as nesting sites) occupied by the bird of concern was recorded. About 15 – 20 minutes were spent at each sampling station. Point counts with unlimited distance were taken. Birds were observed using 7×50 binoculars, and identified to the species level using standard field guides. Standardized niche breadth was calculated using Levin's (1968) Index and niche overlap was calculated using Pianka's (1973) Index.

A total of 3,036 observations were made on 48 bird species. Seventeen species were common to both ecosystems. In the natural forest, species with the highest niche breadths were Spotted Dove (*Streptopelia chinensis*) (0.86) and Common Mynah (*Acridotheres tristis*) (0.65) and in the agricultural area, White-throated Kingfisher (*Halcyon smyrnensis*) (0.86), Brown-headed Barbet (*Megalaima zeylanica*) (0.68), Common Babbler (*Turdoides affinis*) (0.66) and Red-vented Bulbul (*Pycnonotus cafer*) (0.59). This might be due to lower number of competitors. Niche overlap was observed among many species within the understory insectivores in both ecosystems. This is probably due to many foraging opportunities which are provided within the understory layer compared to other layers. The Red-vented Bulbul and Black-hooded Oriole (*Oriolus xanthornus*) (0.34), Common Mynah and Black-hooded Oriole (0.32) and Pale-billed Flowerpecker (*Dicaeum erythrorhynchos*) and Brown-headed Barbet (0.28) had reduced niche overlap in the agricultural land than in the natural forest. This may be due to some opportunistic behaviors of birds which were adapted to use available food sources in agricultural land than in natural forest. Hence endemic bird species and other highly specialized insectivorous species face a high level of competition with opportunistic bird species in the agricultural lands. Hence when biodiversity conservation strategies are designed, the protection of fine-scale habitat diversity should be considered a priority.

Anti-inflammatory activity of *Acronychia pedunculata* leaves

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Acronychia pedunculata ("Ankenda" in Sinhala, Family: Rutaceae) is a small evergreen tree widely distributed in rainforests of Sri Lanka. The leaves, stems, roots and fruits have been used for centuries in folk medicine for the treatment of various diseases such as sores, asthma, cough, diarrhoea, rheumatism, swellings, pain and itchy skin, the disorders associated with inflammatory process. This indicates that the possibility of this plant may contain compounds with anti-inflammatory properties. There is no published information available on in-vivo studies to investigate the anti-inflammatory activity of leaves of *A. pedunculata.* Hence, a present study was focused on investigating the anti-inflammatory activity of 70% ethanol extract of *A. pedunculata* (EEAP).

Carrageenan induced rat hind paw oedema test was used as an experimental model for evaluation of acute anti-inflammatory effect. Healthy adult male, Wistar rats weighing 150-200 g were used for the experiment. The negative and positive control groups were orally administered 1.0 mL of 0.5 % carboxymethyl cellulose (CMC) and 5mg/kg body weight of indomethacin in 1 mL of 0.5% CMC respectively. The test groups were received 50, 100, 200, 300 and 500 mg/kg body weight of the 70% EEAP in 1 mL of 0.5% CMC.

The results showed that the treatment with 100, 200, 300 and 500 mg/kg b.w of EEAP were significantly reduced ($p < 0.05$) paw oedema when compared to negative control. But, the differences among doses of 200, 300 and 500 mg/kg b.w. were insignificant ($p > 0.05$). Hence, the dose of 200 mg/kg of EEAP was selected as an effective dose. The maximum percentage inhibition of rat paw oedema were found to be 77.8 % for dose of 200 mg / kg b.w. at 5th hour while it was 88.9 % for indomethacin which is a positive control.

In conclusion, these preliminary observations provided some valuable evidence for the anti-inflammatory properties of leaves of *A. pedunculata* as it is claimed in folk medicine. Further studies will be undertaken to uncover some of the possible mechanisms of these actions.

Allelopathic activity of some edible fruit extracts against *Lactuca sativa*

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Both synthetic herbicides and fertilizers can exert harmful effects on the environment and consequently affect the health of humans and other animals. Therefore, the focus is on environmental friendly, cost effective, toxicologically safe and biodegradable alternatives to synthetic herbicides and fertilizers. Hence, this study was designed to find out the allelopathic activity of some popular edible fruit extracts. Edible parts of five popular edible fruits of Sri Lanka: *Citrullus lanatus, Limonia acidissima, Nephelium lappaceum, Passiflora edulis* and *Phyllanthus emblica* were separately crushed or blended and filtered. Residue was sequentially extracted into n-hexane (RH), ethyl acetate (RE) and methanol (RM) by sonication for 30 minutes. Sonication was triplicated. Filtrate was successively partitioned with n-hexane (JH) and ethyl acetate (JE). The resulting aqueous phase was freeze-dried (JW). Ten Lactuca sativa seeds were placed on each 90 mm Petri plate lined with a filter paper. Then the filter papers were moistened with 3 mL of extract in 1%DMSO/distilled water and labeled respectively. Seeds were allowed to germinate and grow at dark for 5 days at room temperature. Number of germinated seeds was counted and percentage germination inhibition was calculated with respect to negative controls. If germination was not inhibited, the length of shoots and roots of germinated seeds were measured and percentage growth inhibition was calculated. 1% DMSO/ distilled water was used as the negative control. Seed germination was inhibited by JH extract of *C. lanatus* and JE extracts of *C. lanatus* and *L. acidissima*. Their IC_{50} values were 395, 498 and 766 ppm respectively. Significant inhibition of root elongation was showed by RE and JW extracts of *P. edulis*, RE, JE and JW extracts of *P. emblica* with respective IC_{50} values of 635, 804, 929, 1008 and 984 ppm. Apart from above, other extracts did not show promising effects on germination or growth. Fruit pulp of *C. lanatus, L. acidissima P. edulis,* and *P. embelica* contain phytotoxins. It is worth to subject these extracts to activity guided fractionation to isolate phytotoxic constituents.

Selective capturing of phenol using lignin particles

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Lignin is the second most abundant natural polymer after cellulose, making up to 10-25% of lignocellulosic biomass. Lignin is a three-dimensional, highly cross-linked, aromatic polymer. It is composed of three types of substituted phenols; coniferyl, sinapyl and p-coumaryl alcohols that are linked by enzymatic polymerization, yielding a vast number of functional groups and linkages. There are many lignin sources available and depending on the extraction method physical and chemical behavior of lignin varies. Formic acid treatment followed by peroxyformic acid treatment was used to extract lignin from finely powdered saw dust. The lignin extracted was characterized by FTIR spectroscopy. Sonication and dialysis methods were used to synthesis lignin particles (1-10 µm). By exploiting the specific surface area and the hydrophobic character of lignin particles, it was applied as a biosorbent. Biosorption is one of the methods useful in the treatment of water contaminated with organic pollutants such as dyes and oils. Hydrophobic organic molecules are expected to interact with lignin particles mainly through hydrophobic interactions such as van der Waals forces and π-π stacking. In this study phenol absorption onto lignin particles was investigated in terms of adsorption efficiency and selective adsorption over cyclohexanol. The optimum dosage, pH, shaking time and settling time were investigated to determine the optimum conditions for phenol adsorption. The data were fitted in to Langmuir and Freundlich isotherms and the maximum adsorption capacity and the selectivity were determined.

Conservational significance of Dunumadalawa forest reserve in central Sri Lanka based on the endemism of its avifauna

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Dunumadalawa ($7^0$17'00"N, $80^0$38'49"E; 548-972 m above sea level) is a semi isolated wet-zone forest reserve located on a hill ridge in Kandy. It spans across 480 ha and consists of secondary growth forest. No previous studies have been undertaken on the avifaunal diversity in this forest. Hence the present study was conducted to determine the status of the endemic bird fauna to provide pertinent information to justify the conservational importance of this forest. Field sampling was done from January to September 2015. Data were collected using line transects integrated with a point count method during the day time (peak observation hours 0600-0900 h and 1500-1800 h), and one night sampling session was conducted. Sites were specified by systematic random sampling, assigning GPS points. Sampling stations were separated by a minimum distance of about 200 m; about 15 minutes were spent at each point. Direct identification was done using 8×40 binoculars. Calls were recorded where necessary. The radial distance (m) to each bird contact from the observation point was estimated to determine the density of species using Distance software. As a control, the same procedure was conducted in nearby home gardens (50 m towards north eastward) which represent more disturbed habitat.

The present study verified that the diversity of avifauna in Dunumadalawa is comparatively higher (Shannon Index H'=3.56 and Simpson's Index 1-D=0.959) than the nearby home gardens (H'=2.98, 1-D=0.923) (t test for Shannon Index revealed that the two sites are significantly different p=<0.001; t=4.09; df=17), consisting of 12 species out of 33 endemic bird species in Sri Lanka (36.36%) and 22 endemic subspecies out of 68 (32.35%). The Yellow-fronted Barbet (*Psilopogon flavifrons*) (65 individuals), Brown-capped Babbler (*Pellorneum fuscocapillus*) (35), Crimson-fronted Barbet (*Psilopogon rubricapillus*) (29), Sri Lanka Scimitar Babbler (*Pomatorhinus melanurus*) (14) and Sri Lanka Wood-Pigeon (*Columba torringtoniae*) (9) were the most abundant endemic species. Including them, the forest hosts nine restricted range species out of 27 (33.33%).The additional four are Sri Lanka Junglefowl (*Gallus lafayettii*), Sri Lanka Hanging-Parrot (*Loriculus beryllinus*), Layard's Parakeet (*Psittacula calthrapae*), and Sri Lanka Grey Hornbill (*Ocyceros gingalensis*). These results highlight the relatively high endemism of avifauna in Dunumadalawa, which is a forest fragment that serves as a habitat island surrounded by highly urbanised human settlements. The forest has a high conservational significance given the presence of a considerable number of endemic species, all of which are restricted range species. Therefore we recommend that the findings from this study to be used to conduct a thorough conservation assessment to plan relevant conservation programmes.

Talarofuranone, a new fungal metabolite from an endophytic *Talaromyces purpurogenus* from *Pouteria campechiana* seeds

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Fungi play an important role in our lives and some fungi, such as mushrooms, have been used by humans as food from time immemorial. It can be categorized mainly in to two groups, epiphytic fungi and endophytic fungi. Epiphytic fungi grow on the surface of the host. Endophytes are microorganisms that live in the intercellular spaces of stems, petioles, roots and leaves of plants causing no discernible manifestation of their presence and have typically remained unnoticed. Some endophytic fungi have the ability to produce the same compounds that are produced by their host plant. Camptothecin, huperzine A, podophyllotoxin, taxol, vinblastine and vincristine are some examples of such compounds. We have previously reported several compounds with interesting bioactivities isolated from the endophytes of some Sri Lankan plants. In a continuation of our studies on bioactive secondary metabolites produced by fungal endophytes associated with Sri Lankan plants, we investigated metabolites of an endophytic fungus isolated from the seeds of the *Pouteria campechiana* (Local name: Lavulu) of the family Sapotaceae. An endophytic fungus isolated from the seeds of the *P. campechiana* was identified as *Talaromyces purpurogenus* (syn. *Penicillium purpurogenum*). The pure culture of the *T. purpurogenus* was grown on potato dextrose agar (PDA) media. After four weeks fermentation fungal medium was extracted with ethyl acetate. Chromatographic separation of the EtOAc extract over silica gel, Sephadex LH-20 and preparative thin layer chromatography (PTLC) furnished four UV active (λ 254 nm) compounds **1-4**, which were identified by detail analysis of their ^{1}HNMR, ^{13}CNMR, 2D-NMR and FABMS as talaroconvolutin A (**1**), a furanone analog of talaroconvolutin A (**2**), 4-hydroxyacetophenone (**3**) and tyrosol (**4**). We have previously reported the isolation and structure elucidation of compounds **1**, **3** and **4**. Here we report the isolation and characterization of compound **2**, which was found to be a new natural product and named as talarofuranone (**2**). It is noteworthy that 4-hydroxyacetophenone (**3**), which was obtained from the extract of *P. campechiana* seeds in our previous study, has now been isolated as a secondary metabolite of the endophytic fungus *T. purpurogenus* from *P. campechiana*.

Effect of dengue insecticide fogging on cashew pollinators and other non-target insects

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Cashew, *Anacardium occidentale* (Anacardiaceae) is one of the most traded nuts grown in tropics. In Sri Lanka, cashew cultivators complain that the recent decline in cashew production is due to low pollination resulted from continuous insecticide fogging operations made to control dengue vectors. Present study was aimed to assess the effect of widely used Pesguard FG161 (d-tetramethrin 4% +cyphenothrin 12%) fogging, on cashew pollinators and other non-target insects in a high cashew growing area.

Six fogging trials were conducted in two community settings *i.e.* urban and village, in Batticaloa, between 6.30 - 8.30 a.m. during June, 2015 to February, 2016 to cover the cashew flowering season. In each trial, Pesguard FG161 was sprayed for 8 minutes using a pulse jet thermal fog generator according to the recommended methodology in an area of 200 m² and the insects knocked down on randomly spread polythene sheets were collected after 30 minutes. Insects recovered 24 hours and the dead were separately recorded and identified up to the family level.

Cashew plants were spread over village area and few plants were found in town area. During the six fogging trials, 1,708 knocked down insects were collected from 60 m² area of polythene coverage and 7.1% of them recovered within 24 hrs. Significant differences of knocked downs, mortalities and affected insect families between the two sites were analyzed by two-way ANOVA using Minitab 15 statistical software package. Results shows that knocked downs and mortalities between the two sites were not significantly different (P>0.05). Highest mortalities in the town area was from the family Sminthuridae (Collembola) (28.8%) followed by Formicidae (Hymenoptera) (16.0%), and Cicadellidae (Hemiptera) (9.1%), in village area, highest mortality was from Aleyrodidae (Hemiptera) (30.8%) followed by Cecidomyiidae (Diptera) (8.0%) and Sciaridae (Diptera) (7.2%). From the total mortalities, 33.3% were potential cashew pollinators (wasps 6.5%, ants 8.6%, thrips 7.1%, dipterans and coleopterans 11.2%) and only 0.3% was mosquitoes *i.e. Aedes albopictus* (2), *Culex quinquefaciatus* (2), and *Armigerus subalbatus* (2). Although mortality percentages of each insect family differ between the two sites, insect diversities of the two sites were only slightly different (H′ town =2.73 and village=2.89).

The study shows that insecticide fogging seriously affect the insect pollinators and can make a significant impact on cashew production, if operated during the flowering season. This has to be taken into consideration in planning vector mosquito control programs and the indiscriminate fogging practices should be avoided.

Effect of tea waste biochar on soil acidity amelioration on acidic tea growing soils of Sri Lanka

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Soil acidification is a major constraint that reduces productivity in tea lands. Therefore, regular liming has been recommended for tea cultivations to maintain the optimum pH range in soils. Biochar has been considered as an ameliorant for soil acidity because of its alkaline nature. Biochar (BC) made from tea factory wastes was evaluated for their potential to reduce acidity in two tea growing Red Yellow Podsolic (RYP) soils of Sri Lanka. Biochar produced at 300°C was applied to Mattakelle series (MK) and Pallegoda series (PG) soils at rates of 0% and 2% (w/w). Changes in soil pH over 56 days were measured. Changes in the pH buffering capacity of BC amended soils were also measured. Soon after BC addition, soil pH increased in both soils and the increase was greater in PG soil. The soil pH decreased with time, thereafter. At the end of the incubation period, soil pH increase over the control treatment were 0.11 units in MK soil while 0.67 in PG soil due to the differences in the pH buffer capacities of the two soils. Soil pH buffering capacity was high in MK than that in PG soils. This was further increased ($p<0.01$) due to Biochar application. The increase in buffering capacity was greater in PG soil (54%) than in MK soil (11%). We conclude that low temperature BC made from tea factory wastes is an effective ameliorant for countering acidification of tea growing RYP soils in Sri Lanka, particularly for soils having low pH buffer capacity.

Efficacy of *Aloe vera* against the pathogen *Aeromonas hydrophila* infecting gold fish

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Aloe vera, a herb with known antibacterial properties, has not been fully exploited in aquatic medicine. Therefore, the present study was conducted to evaluate the effectiveness of *Aloe vera* in gold fish experimentally infected with *A. hydrophila*, a strain isolated from a septicaemic gourami *Trichopodus leerii*.

To test the *in vitro* antibacterial effect of *A. vera* against the above strain, an agar gel diffusion test was employed using the supernatant of *Aloe vera* gel homogenate collected from fresh and mature leaves. In addition, to test the effect of *A.vera* against *A.hydrophia in vivo,* experimental feed number 1, 2 and 3 containing *20%, 33.3% and 42.9%* of *A.vera* gel, was prepared respectively. Seventy two gold fish were divided into four groups (n=18; 6 fish per tank with three replicates) and the groups 1, 2 and 3 were fed with experimental feed number 1, 2 and 3, respectively while the group four was fed with a control feed without *A.vera.* All the above groups were fed with respective diets twice daily at a rate of 0.5 g per tank for 56 days. The body weights were taken at day 0 and day 42 of the experiment. On day 42, all fish from groups 1 to 4 were injected intraperitoneally with an overnight broth of *A.hydrophila* at a dose 2.42×10^4 cfu per fish and observed daily for a period of 14 days.

A.vera gel supernatant inhibited the growth of *A. hydrophila* in a dose dependent manner *in vitro*. There is no statistical difference among the body weight gain of group 1 (0.7g), 2 (0.87g), 3 (0.87g) and 4 (0.65g) ($p > 0.05$). Further, upon artificial infection with *A. hydrophila* the survival rate of groups 1 (55.5%), 2 (66.6%), 3 (66.6%) were higher than that of control group (5.55%) ($p < 0.05$). The *in vitro* and *in vivo* effectiveness of *A. vera* against *A. hydrophila* suggests that *A. vera* can be used as a cheap alternative to antibiotics to control *A.hydrophila* infections in gold fish.

Effect of tissue type on the development of myiasis-causing fly, *Chrysomya bezziana* (diptera: calliphoridae) under controlled conditions

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Myiasis is the infestation of live human and animal tissues with fly maggots. *Chrysomya bezziana* Villeneuve (Diptera: Calliphoridae) is one of the myiasis-causing obligatory parasitic fly species in the world. Temperature and tissue type on which the larvae feed are known to directly affect the development rate of the fly larvae. This study was conducted to identify the effect of three tissue types (bovine and porcine meat and porcine liver) on the development rate of *C. bezziana* at 35°C, from egg to adult. Eggs for the study were obtained from an adult colony maintained in the insectary of the Department of Zoology, University of Pearadeniya.

In separate rearing jars (400 cc), three meat pieces (100 g each) from each of the three tissue type were placed individually on top of a 2 cm sawdust layer and 100 eggs placed on each tissue. Three replicates were conducted for each treatment. The containers were placed in a growth chamber at 35°C and 75 % RH. Eggs were observed hourly until hatching. At four hourly intervals, 2-3 larvae were collected and preserved in 70% alcohol. Larval length, (using a digital microscope), cross width (using a vernier calliper) and instar stage (morphological features) were recorded. From 3rd instar stage onwards, observations were made every 12 hours until adult emergence. Data were analyzed using analysis of covariance method (ANCOVA).

The highest rate of length and cross width change in larvae was observed in bovine meat followed by porcine meat and liver. Highest development rate was recorded in bovine meat (262 h) followed by porcine meat (286 h) and liver (307 h) respectively. ANCOVA analysis on development rates of larvae revealed a significant difference ($P<0.05$) in length ($P= 0.006$) and cross width ($P<0.001$) of larvae in relation to time. The study reveals that the rate of development and larval size of *C. bezziana* varies with different tissue types. This may be due to variations in nutrient factors, moisture content, texture, as well the individual preference of *C. bezziana* for each tissues type. This work reports the very first study on the development of medically and forensically important fly species in tropical Asia.

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Potential of gamma-ray spectrum analysis as a method to determine radioactive elements in geological samples

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Natural gamma-ray spectrometry can be used to measure the activity of Potassium-40 (^{40} K), Uranium-238 (^{238} U) and Thorium-232 (^{232} Th) in geological samples. The knowledge of activity of ^{40} K, ^{238} U and ^{232} Th can be used to determine the concentration of respective elements present in the sample. In this research rock and soil samples were collected from various geological locations, which were suspected as radioactive mineral bearing samples. X-ray florescence analysis was carried out to take a rough idea about the elements present in the sample. A thorium rich sample was selected for further analysis. The rock sample was crushed and completely filled to the standard cylindrical geometry. It was weighted and sealed such that radon gas would not escape from the sample. The Sodium Iodide (NaI) detector set up available in the nuclear physics laboratory, Department of Physics was used to obtain the gamma-ray spectrum. Sample was analyzed for two hours. For room background subtraction, background spectrum was obtained for the same time with no source in front of the detector. The gamma-ray spectrum analyzed by Genie 2000 software was used to determine ^{232} Th wt. %. Then the sample was analyzed by High purity Germanium (HpGe) detector model BE5030 in the Nuclear Analytical Laboratory, Life Science Division, Atomic Energy Board. The sample was analyzed with respect to standard samples obtained from Analytical Quality Control Service of the International Atomic Energy Agency. The three standards of ^{40} K, ^{238} U and ^{232} Th were prepared according to same geometry of the sample. The gamma ray spectra of sample and three standards were used to determine ^{232} Th wt. %. The HpGe detector analysis confirmed that ^{232} Th wt. % is 2.5 on average. The same average ^{232} Th wt. % value was obtained from NaI detector analysis, considering 2615 keV and 911 keV peaks. Therefore, it can be suggested that 2615 keV and 911 keV are the best peak for ^{232} Th detection. Furthermore, it can be confirmed that the NaI detector is still capable of analyzing samples accurately up to International Atomic Energy Agency (IAEA) standards.

Isolation and identification of lipase inhibitors from *Trigonella foenum-graecum* seeds

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The use of spices as food additives has been practiced widely since ancient times. Apart from enhancing the taste and flavor of food, spices have been widely believed to exert medicinal properties. Obesity has become a worldwide health problem and identification of plant materials and their compounds as natural anti-obesity agents has become a need. The present study describes the detailed bioassay guided fractionation for the crude methanol extract of *Trigonella foenum-graecum*, in search of lipase inhibitors as anti-obesity agents.

During our previous studies methanol extract of *Trigonella foenum-graecum* showed the highest lipase inhibitory activity. Therefore, it was subjected to solvent-solvent partitioning using hexane, ethyl acetate, methanol and water. Identification and quantification of lipase inhibitory activity in the fractions was accomplished using DMPTB as the substrate and porcine pancreatic lipase as the enzyme. Water fraction was having the highest lipase inhibitory activity and chromatographic separation of water fraction over combination of chromatography over sephadex LH-20, reverse phase silica and reverse phase HPLC furnished two compounds as Compound 1 and 2.

All the fractions (*n*-hexane, ethyl acetate, methanol and aqueous fractions) had inhibitory effects on the lipase activity and the highest inhibitory potency was observed for the aqueous fraction of *Trigonella foenum-graecum* (70.11%).Quantitative analysis of lipase inhibitory activity revealed that compound 1 (60.27%) and 2 (33.77%) to have inhibition of the lipase enzyme. Subsequently compound 1 was identified as vicenin1 (apigenin 6-C-xylosyl-8-C-glucosyl) and compound 2 as isoschaftoside (apigenin 6-C-α-L-arabinopyranosyl-8-C-β-D-glucopyranoside) by detail analysis of NMR and MS studies. This study has identified two lipase inhibitors from *T. foenum-graecum* seeds by bioassay guided purification. Vicenin 1 and isoschaftoside could be considered as moderate lipase inhibitors. This is the first isolation and identification of lipase inhibitors from *T. foenum-graecum* seeds.

Fabrication of nano zero valent iron on kaolinite templates by a green pathway

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Nano zero valent iron (n-ZVI) is extensively used as a strong reductant for the environmental remediation of a wide array of organic and inorganic contaminants including nitrates. The major issues associated with nZVI are its hyper-reactivity and ready agglomeration resulting serious problems associated with storage and reactivity's yield to benign products. In this research we proposed synthesizing nZVI using green tea extracts onto kaolinite. The newly synthesized nZVI (hereafter GT-nZVI) is employed to chemically reduce nitrate found in water. Nitrate is a priority pollutant in Sri Lankan drinking water systems. Hitherto date most of the nZVI technologies are utilized for in situ remediation programs. In this research feasibilities will be sought to utilize GT-nZVI in community water treatment schemes. The other objective is to fabricate the GT-nZVI optimizing ammonia as a major product of nitrate reduction. The ammonia thus generated will be stripped off with free Cl_2 producing chloroamines that can be subsequently used as a safe disinfectant. In accordance with these aims we have synthesized air stable GT-nZVI on kaolinite templates. The Fe (II) ions retained on dispersed locations on kaolinite surface for formation of nZVI on edges by the reduction into metallic iron by green tea extracts. Further, the high concentrations of caffeine/ polyphenols present in solution play a dual role; as a reductant and as a capping material forming a protective shell around the nano particles. The GT-nZVI particles were characterized by spectroscopic and classical methods. The proton surface titrations confirmed a pH_{zpc} of the GT-nZVI was ~2.00 which dominates negatively charged surface sites.

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Synthesis of zero valent iron nanoparticles and application in nitrate reduction

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Iron nano particles have received greater attention due to its potential application in nitrate (NO_3^-) reduction in drinking water. Zero valent iron nanoparticles (nZVI) have more advantages over micro scale zero valent iron (mZVI) due to high surface area and small size. nZVI were synthesized by a chemical method where, ferrous ions were reduced to ZVI by sodium borohydride. Characterization of the surface of synthesized nZVI was done by X-ray diffraction spectroscopy (XRD), Fourier Transform Infra-red (FTIR) Spectroscopy, Zeta potential, surface titration, Mossbauer Spectroscoy, Scanning Electron Microscopy (SEM), redox potential (Eh) and X-ray photoelectron spectroscopy (XPS). These data suggested that bare ZVI particles tend to undergo oxidation and aggregation. To overcome the above problems, poly ethylene glycol (PEG) was used as the stabilizer. Synthesized nZVI were used in nitrate reduction effectively. Nitrate reduction efficiency of nZVI was investigated as a function of pH values and initial iron loading. Observed data confirmed that similar to mZVI, nZVI can be used in NO_3^- reduction where it has higher efficiency over mZVI. Ammonia (NH_3), nitrous oxide (N_2O) and nitrite (NO_2^-) was observed as the product of nitrate reduction by nZVI. NH_3 and NO_3^- were determined using ion selective electrode (ISE), N_2O by gas chromatography (GC) and NO_2^- by colorimetry.

Quantitative analysis of Gold alloys using NaI (Tl) scintillation detectors through neutron activation

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The use of thallium induced sodium iodide detectors in quantitative analysis is not usually done because of its low resolution. However, its relative ease in handling and not being as expensive as other detectors are the reasons for its use. This project aims at devising a procedure to do a quantitative analysis on samples made of gold and copper. The samples were activated by using an Am-Be neutron source. The flux of neutrons and the interaction between neutrons and the target atomic nuclei vary with neutron energy, hence the product of neutron flux density and neutron capture cross section was first found for pure known gold and copper samples. A small part of an earring was tested for its karat value ((mass of gold/total mass)*24) using an XRF spectrometer on multiple points. The XRF readings gave an average karat value of 22.54. After activation, the resulting gamma ray spectrum was analyzed. This gave a karat value of 15. The calculated total mass of the object was only 15% less than the actual mass. It was observed that the object was made by welding together two 22 karat parts by using copper. This excess copper could not be accounted for by using an XRF spectrometer because of structural hindrances. Confirmation tests were done by activating a sample made in the laboratory consisting of a copper sheet wrapped in a gold sheet. The value obtained for the karat value was 21% lower than the actual value, but the mass of the copper sample obtained was only 3% lower than the actual value. The experiment was done by assuming that the objects tested were small enough to be considered to be point objects, and the attenuation of the emitted gamma rays were not considered due to the complex nature of the sample structures. Given the accuracy by which the copper content was measured even with the assumptions, this procedure can be used to identify irregularities in the karat value of objects made using copper and gold alloys with further improvements.

Comparative studies of bio activity and chemistry of combined plant extracts

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Diabetes and hyperlipidemia are non-communicable diseases which have been major health problems in Sri Lanka and recent reports have shown that there is an increased prevalence among young adults. At present there is a big demand for natural remedies used in Ayurvedic medicine for these conditions due to the adverse perceptions regarding prolonged usage of synthetic drugs. The key traditional therapeutic herbal strategy applied in ayurveda is the combining of several medicinal herbs to achieve extra therapeutic effectiveness, usually known as polypharmacy or polyherbalism. This study mainly focused on the importance of the polyherbalism and its clinical and chemical significance, utilizing a plant mixture made of leaves of *Murraya koenigii* and fruits of *Garcinia quaesita* Pirre, used for diabetes treatments.

A comparative study of bio activity and chemistry of plant extract mixtures of *leaves* of *M. koenigii* and fruits of *G. quaesita* with respect to their individual plants is reported. Bioactive compounds of both plants are proven to have many functional properties. However, chemistry and bioactivity of combined plant extracts have not been reported thus far. In this study, for each plant and the mixture, antioxidant activity (using DPPH radical scavenging assay), cytotoxicity using the brine shrimp (*Artimea salina*) lethality assay and the total polyphenol content (TPP) by Folin-Ciocalteu method (expressed as the gallic acid equivalent (GAE) in milligrams per gram of dry material) of hexane, ethyl acetate (EtOAc), methanol (MeOH) extracts were investigated. Furthermore, chemistry of the methanol and the ethyl acetate extracts were compared using gas chromatography and all methanol extracts were further analyzed using high performance liquid chromatography (HPLC). All the plant extracts showed antioxidant activity between IC_{50} 8.02-340.8 ppm compared to that of α-tocopherol (IC_{50} 13.46 ppm). The ethyl acetate extract of *M. koenigii*(ME*)* and the hexane extract of *G. quaesita* (GH) have relatively high antioxidant activity with IC_{50} of 8.02 and 8.74 ppm respectively, while the combined plant extracts of hexane(CH) and EtOAc (CE) showed antioxidant activity of 9.74 ppm and 28.72 ppm respectively. All the plant extracts except for the MeOH extract of *G. quaesita* (GM)(LC_{50} =100.89) and hexane extract of *M. koenigii* (MH) (LC_{50} =318.27) showed the higher cytotoxicity and the GH showed the highest LC_{50} values of 0.45 ppm among all the extracts compared to that of positive control ($K_2Cr_2O_7$ LC_{50} 35.78 ppm). The combined plant extracts of hexane (CH), EtOAc(CE) and MeOH(CM) have the cytotoxicity values in between *M. koengii* and *G. quaesita.* The highest TPP content 32.04 mg (GAE)/g was obtained for the CM. Gas chromatography and HPLC studies of the plant mixture showed new peaks, which do not appear in their individual methanol extracts. Further, HPLC studies of the mixture showed absent of peaks, which were appeared in their individual methanol extracts. This preliminary study showed that, chemistry of combined plant extracts is differing from the individual plant extracts and it may have resulted the observed synergistic effects on their bioactivities. Future studies will be focused on further identification of the new peaks appeared in GC and HPLC chromatographic studies and isolation of those responsible compounds.

Electrochemical reduction of carbon dioxide in the presence of a cobalt schiff base complex synthesized from 2, 4-dinitrophenylhydrazine and acetylacetone

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The concentration of carbon dioxide in the atmosphere has been increasing drastically during the last few decades. Industrialization and development in transportation have caused a massive increase of consumption of fossil fuel, which is the major cause of the carbon dioxide into emission atmosphere. Excessive amounts of carbon dioxide in air can cause global issues such as elevation of temperature, climate changes, acid rains, elevation of the sea level etc. Converting carbon dioxide into useful organic compounds is a potential way to reduce the amount of carbon dioxide in the atmosphere. However, the major obstacle preventing efficient fixation of carbon dioxide is its inertness. Therefore, scientists are interested in increasing the efficiency of this conversion via association of catalysts. Transition metal complexes have been studied widely for their electrocatalytic activity on reducing CO_2. These complexes act as homogeneous catalysts for the reduction process and have reached efficiencies as high as 43 in terms of iCO_2/iN_2. Schiff bases are nitrogen analogues of carbonyl groups. The nitrogen centre of these compounds can be used to coordinate with metal centres to form Schiff base metal complexes. These sorts of complexes have shown promising results on electrocatalytic activities in recent years. In this study, a Schiff base complex of cobalt was studied for its electrocatalytic activity on reduction of carbon dioxide. Cyclic voltammetry is used to study the electrochemical behaviour of the complex throughout the study. The reduction potential of carbon dioxide was found to be -0.86 V in the presence of the complex in DMF with respect to the saturated calomel electrode. This potential is very low compared to cyclam which reduces CO_2 at a potential of -1.5 V, making the process of reduction of CO_2 more thermodynamically feasible in the presence of the studied complex. The efficiency of reduction in terms of iCO_2/iN_2 was found to be 1.76.

Effect of five pesticides on juvenile terrestrial stages of the common hourglass tree frog, *Polypedates cruciger*

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Numerous studies provide evidence of lethal and sub-lethal effects of pesticides on aquatic stages of amphibians. However, effects of pesticides on terrestrial stages are largely neglected. Agricultural lands often receive pesticides at high concentrations and amphibians with their permeable, moist skin should be highly vulnerable to pesticides. This study examined the acute toxicity of five commonly used pesticides on terrestrial stage of juveniles of *Polypedates cruciger*. A total of 130 healthy, laboratory-reared juveniles (<7 days post-metamorphic) of *P. cruciger*, which were never exposed to pesticides were used for the experimental exposure. Commercially available, formulated products of five chemicals were used: an insecticide (Carbosulfan), two fungicides (Tebuconazole and Chlorothalonil), and two herbicides (Azimsulfuron and Fenoxaprop-p-ethyl). Two concentrations (maximum recommended concentration for field application and 5×recommended concentration) of each pesticide were selected for the experiment to stimulate a real field application and a worst-case scenario. Maximum recommended concentrations of Carbosulfan, Tebuconazole, Chlorothalonil, Azimsulfuron and Fenoxaprp-p-ethyl were 800, 150, 1500, 78 and 82.5 mg/L, respectively. A hand-held spray bottle was used to spray the calculated volume of each pesticide (2, 2, 4.5, 2 and 1.5 ml respectively) evenly into the tanks (surface area 450 cm^2) containing five juveniles. After seven days, mortalities ranged from 0–50% and 0–80% for recommended and 5× recommended concentration respectively; no mortality occurred in the controls. At recommended concentration, Carbosulfan and Tebuconazole caused relatively high mortality (50% and 20% respectively). The two herbicides (Azimsulfuron and Fenoxaprop-p-ethyl) and fungicide Chlorothalonil caused no mortality at recommended concentration, and less than 10% mortality was observed at 5× recommended concentration. Our results indicate that direct overspray of certain pesticides even at the recommended concentrations for field application could be highly lethal to juveniles of *P. cruciger* and presumably many other amphibians. Except for fungicide chlorothalonil, which is used mainly in vegetable cultivation, all the other pesticides used in the study are used for paddy cultivation. Agricultural lands, particularly paddy fields, support a considerable diversity of amphibians. Therefore terrestrial stages face the risk of direct exposure of these chemicals. This study generates baseline information required for establishing a pesticide risk assessment procedure that would incorporate the terrestrial amphibian toxicity information as well. Currently such assessments do not consider amphibians before a new pesticide is released to the market.

Study of decomposition of acetic acid, ethanol and isopropyl alcohol by the Fenton reagent

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The Fenton reagent, a mixture of H_2O_2 and Fe^{2+}, is a powerful oxidant that could be used to reduce the COD values of industrial wastewater. It has been suggested that acetic acid could significantly reduce the efficiency of the decomposition of organic compounds. This study mainly focused on studying the decomposition behavior of acetic acid, isopropyl alcohol and ethanol by the Fenton reaction. All the experiments were done using aqueous solutions of ethanol (0.05 M), isopropyl alcohol (0.04 M) and acetic acid (0.04 M). The Fenton reagent was composed of 0.04 M H_2O_2 and 0.0027 M Fe^{2+}. The Fenton reaction was initiated by introducing 1.0 mL of the reagent to 100.0 mL of the organic solution. The residual amounts of the Fe^{2+}, H_2O_2 and COD values were determined on hourly basis for 5 to 6 hours using standard methods. According to the experimental data, the reduction of COD was about 60 % for ethanol and isopropyl alcohol solutions and about 30 % for acetic acid. The consumption of H_2O_2 during the reaction was about 55% for both ethanol and isopropyl alcohol and about 35% for acetic acid. In addition, the Fe^{2+} to Fe^{3+} ratio was similar for ethanol and isopropyl alcohol and it was significantly different for acetic acid. These experimental data suggest that under similar experimental conditions, the decomposition of ethanol and isopropyl alcohol is different from acetic acid by the Fenton reagent. It has been suggested that acetic acid forms stable complexes with Fe^{3+} that is produced by the oxidation of Fe^{2+} during the Fenton reaction. As a result, the catalytic cycle of Fe^{2+} and Fe^{3+} might have been interrupted by acetic acid. In order to prevent the formation of Fe^{3+}- acetic acid complexes, citric acid was added as a competitive ligand. The addition of small amounts of citric acid along with the Fenton reagent significantly improved the decomposition of acetic acid and a 55 % reduction was observed after 5 hours. On the other hand, decomposition of ethanol was not significantly influenced by the addition of citric acid under similar experimental conditions to acetic acid.

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Life cycle of brown dog tick *Rhipicephalus sanguineus* latreille, 1806 under laboratory conditions

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The brown dog tick, *Rhipicephalus sanguineus* (Acari: Ixodidae), is a three-host hard tick that feeds primarily on dogs, occasionally on other animals and rarely on humans. It is widely distributed around the world and acts as a vector of many pathogens, such as *Babesia canis*, *Ehrlichia canis*, and *Rickettsia conorii*. In Sri Lanka, *R. sangenius* has an island-wide distribution and is identified as the dominant dog tick species in the Wet zone. Biological parameters of the life cycle of *R. sangenius* were collected by experimental infestation of New Zealand white rabbits under laboratory conditions (Temperature 27±1°C; Relative humidity 70%-80%). All the life cycle stages: larvae, nymphs and adults successfully fed on the rabbits under laboratory conditions. Engorged females (n=47) had a mean weight of 133.2 (54-187) mg, completed oviposition in 14 (3-19) days with an average pre-oviposition period of 4.9 (4-7) days. Females laid an average of 1,414.2 (101-2760) of eggs. Eggs hatched after 29.6 (21-43) days of incubation. Larvae (n=100) had a parasitic period of 3.1 (2-3) days. Of the larvae introduced, 62.7% successfully fed on rabbits and dropped off. The unfed larvae survived up to 65.3 (52-73) days. Total of 31.1% nymphs dropped after 5.1(4-5) days and the moulting period was 14.3 (13-15) days, which had a mean weight of 5.4 mg. Unfed nymphs survived for up to 58 (37-45) days in the laboratory. The parasitic period of adults was 15.7 (7-15) days. The adult ticks (n= 15) completed feeding within 15.7 (7-15) days. Blood fed adult females lived for 18.2 (15-22) days and blood fed male lived for 317.4 (292-355) days. The Reproductive Efficiency Index (REI) and Reproductive Fitness Index (RFI) of the female were 12.7 (22-70) and 8.8 (1.8-20), respectively. The male to female sex ratio was 5:2 in laboratory raised adults. *Rhicephalus sangenius* completed its life cycle within 115.6 (±6.9) days. There are variations in the life cycle of Sri Lankan population of *R. sangenius* when compared to that of Italian and United States populations. These variations could be due to environmental conditions in different geographic regions.

Sri Lankan vein graphite / polyaniline composite counter electrode for dye sensitized solar cells by screen printing method

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Dye sensitized solar cells (DSSCs) are emerging as promising materials which use renewable solar radiation for ever increasing energy crisis. DSSCs entitled as one of the most prominent third generation solar cells, stand out in the photovoltaic category. Counter electrode (CE) of DSSC is one of the main components which catalyze the redox reaction taking place in the cell and it collects electrons from the external load and sends them to the electrolyte. Platinum (Pt) is widely used as counter electrode material as it gives high efficiencies. However since Pt is extremely expensive, diminishing noble metal and decrease in catalytic activity when exposed to dye solution encourage researchers to find alternatives for Pt electrodes. In this study we report the use of Sri Lankan vein graphite/polyaniline composite as a new counter electrode material. Sri Lankan vein graphite is highly crystalline and is a good low cost alternative to expensive Pt. Polyaniline (PANI) is used as the conducting polymer along with graphite because of its high electrochemical activity. Polyaniline was prepared by oxidative polymerization using aniline and Potassium peroxydisulfate. Polyaniline/Graphite composites were screen printed on Fluorine doped Tin Oxide (FTO) glass substrate using Carboxy Methyl Cellulose (CMC) as the binder. The performance of the new counter electrode was studied by analyzing the I-V characteristics of the DSSCs and the highest efficiency of 5.04% with fill factor of 71.54%. DSSCs with new counter electrode were further characterized by using X-ray diffraction and Fourier Transform Infrared studies.

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Comparison of avifaunal diversity in different habitats in Jaffna peninsula

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The Jaffna Peninsula has been identified as an Important Bird Area by the Bird Life International. The overall objective of the present study was to document bird species richness in four different habitats in the Jaffna peninsula. The study was carried out based on vegetation variability in a mangrove ecosystem in Mandaitivu, a coastal area in Araly, a paddy field in Mallakam, and a home garden in Kokkuvil from January to December 2014 using variable width line transect as most of the areas are open habitats. Bird counting was carried out by walking along a two kilometer fixed route transect for one hour between 0630-0830 h and 1530-1730 h. Mean annual temperature varies between 25.24 - 31.60 ^{0}C and total annual precipitation was 1368.6 mm in Jaffna in 2014. A total of 75 bird species in 40 families were recorded in the present study. Fifty three species (70.67%) used mangroves (Simpson Diversity Index: 0.96), 45 (60.00%) used coastal area (0.96), 36 (48.0%) used paddy field (0.90), and 21 (28.0%) used home garden (0.90). Mangroves and coastal area showed higher diversity. Sixteen species, including two uncommon breeding residents, the Spot-billed Duck (*Anas poecilorhyncha*) and Little-ringed Plover (*Charadrius dubius*), and three rare migrant species, the Grey Plover (*Pluvialis squatarola*), Eurasian Curlew (*Numenius arquata*) and Whimbrel (*N. phaeopus*) and two uncommon winter migrants, the Greater Flamingo (*Phoenicopterus roseus*) and Western Reef Egret (*Egretta gularis*) were recorded in Mandaitivu. The Common Ringed Plover (*Charadrius hiaticula*) was recorded in Araly and Mandaitivu. This may be due to habitat heterogeneity. A rare breeding resident, the Common Coot (*Fulica atra*) was recorded in Mallakam. Home garden and Paddy field showed lower diversity. This may be due to increased anthropogenic activities. Three bird species that are mostly restricted to the northern and northwestern regions of Sri Lanka, the Black Kite (*Milvus migrans*), Grey Francolin (*Francolinus pondicerianus*) and Black Drongo (*Dicrurus macrocercus*) were also recorded during the present study. The present study indicates that coastal areas in Araly and Mandaitivu support higher numbers of migratory bird species during the migratory season from early September to late April. Hence these are important sites for the conservation of these species. Therefore, further research is essential to study the ecology of birds in the coastal areas of the Jaffna Peninsula.

Does shading affect hatching success and sex ratio of hatchery relocated eggs of green turtles?

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The hatching success and sex ratios of hatchery relocated eggs of the green turtle (*Chelonia mydas*) buried in two incubation pens receiving different amount of sunlight were studied. Two incubation pens: one under shady conditions and the other one under direct sunlight in the same hatchery enclosure were selected in a hatchery in Bentotain the Southwestern coast of Sri Lanka. Data loggers, programmed to record temperature every 60 mins at 0.5 ºC increments, were wrapped in a plastic bag and were placed inside the nest at the time of the reburial of eggs. Once all hatchlings came out, the percentage hatching success was calculated and the nest temperature data were downloaded onto OneWireViewer version 0.3.17.44 interface. The mean middle third incubation temperature was calculated to estimate the sex ratio of the hatchlings. Data was gathered from 14 nests with a total of 1,314 eggs for a period of one year from March 2015 to March 2016.There was no significant difference in the hatching success of the eggs incubated in the shady (86.6%) and the sunny (84.6%) incubation pens (Chi square test; p>0.05). The hatching success of the green turtle eggs in the present study was much higher compared to nearby hatcheries (52%) and that of the natural nests (77%) on Kosgoda beach. The mean middle third incubation temperature in the shady incubation pen (29.3°C) was significantly lower than that of the pen in the sunny area (33.3°C; Student's *t* test,*t* = 10.58, p = 0.005). For sea turtles, temperatures below 28ºC during the middle third incubation period have known to produce 90-100% males and temperatures of 30.5ºC or higher produce 94-100% females. This shows that the hatchling population of the eggs incubated in the sunny area was highly skewed towards producing more females. The present study reveals that the location of the pen has no effect on the hatching success but the presence of shade regulates the temperature within the nests in the incubation pens thereby contributeing to maintain the pivotal temperature that leads to having advantageous sex ratios than the eggs incubated in pens exposed to direct sunlight.

Through hole copper plating on printed circuit board activated with a conducting layer of polyaniline

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This study is based on development of a simple method to deposit copper on printed circuit boards (PCB) to facilitate through hole copper plating. A PCB is usually a plastic material consists of glass fiber and has no electric conductivity. There are single, double and multi layered PCBs with copper tracks. When the number of components becomes too much for a single sided board, double sided and multi layered boards are used. In these types of boards, electrical connections between the copper tracks of different layers are made by copper plating the inner walls of the holes. As the through hole plated boards commercially manufactured demands high cost, this study is focused on developing an efficient and simple method.

The method includes pre-treatment, activation and electroplating steps. In the activation step, the non-conducting PCB material is made electrically conductive by employing the conductive form of Polyaniline (PANI), in order to carry out an electroplating. The hydroxyl groups on the PCB surface are used to covalently attach aniline molecules which initiate the formation of a PANI layer, which ultimately results in a considerable amount of conductivity, sufficient for an electroplating. The PANI coated PCB's are subjected to copper electroplating by placing it as the cathode. The method is optimized by varying both electroplating conditions and activation conditions to obtain a better copper deposition. The selected electroplating conditions are electrolyte concentration, electroplating time and applied voltage. The activation conditions are varied by synthesizing PANI on PCB in different methods and the resistance of PCB was recorded.

The conductivity of PANI on PCB greatly influences the copper deposition. Varying only the electroplating conditions led only to a poor deposition whereas improvements in activation steps resulted in a good deposition. A smooth better deposition is obtained with improved conductivity and increased thickness of PANI even under moderate electroplating conditions. Good abrasion resistance and better adhesion of copper to the PCB is achieved in this method.

Natural Sciences

Novel method for synthesis of unstable vaterite polymorph of hollow calcium carbonate nanoparticles and encapsulation of anticancer drug cisplatin

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Calcium carbonate particles have widespread technological applications in paper, pharmaceutical, textile, rubber, plastic, paint, cosmetic, toothpaste, glove and other industries. Calcium carbonate mineral has several polymorphic forms of which calcite is the most stable form. Other polymorphic forms include aragonite and vaterite which are less stable. The use of nanoparticles instead of micro or macro particles in industries drastically reduces the material requirement and hence development of methods to prepare nanoparticles is important. However, usual sol-gel synthesis of calcium carbonate nanoparticles results in the formation of the stable polymorph, i.e., calcite, or amorphous calcium carbonate. In this research, we have developed a novel method to prepare thermodynamically unstable vaterite nanoparticles using a soft-template method and to stabilize them under ambient laboratory conditions. In this method, the soft-template is formed using ethylene glycol and water and calcium carbonate is prepared in the aqueous solution of the soft template. The hollow, spherical hydrogen-bonded structures formed from water and ethylene glycol molecules lead to the arrangement of calcium and carbonate ions in a spherical structure thus leading to the formation of vaterite. This has been confirmed by SEM images taken without heat treatment, X-ray diffractogrammes and FT-IR spectra of the product. SEM images also show the porous nature of nanoparticles. Particularly, the FT-IR absorption bands at 877, 745.8 and 1084 cm^{-1} confirm the presence of the vaterite polymorph of $CaCO_3$. Absence of absorption bands at 854, 712, 700 cm^{-1} and 848, 714 cm^{-1} indicates the absence of calcite and aragonite polymorphs. BET surface area analysis indicates 60% porosity in the particles. Particle size analysis in the solution phase reveals that the colloidal solution prepared contain three discrete sizes of particles with diameters 25 nm, 35 nm and 50 nm. The vaterite nanoparticles prepared are dispersed in the aqueous solution of cisplatin in saline water and stirred for 24 h. The product separated from centrifugation followed by filtration is washed several times with distilled water and dried under ambient laboratory conditions. The FT-IR of the product contains N-H stretching, N-H wagging together with CO_3^{2-} vibrations. XRF spectrum shows Ca, Pt and Cl peaks with Pt:Cl atomic ratio close to 1:2. Both these information suggest the presence of both vaterite and cisplatin in the product. Since the product was thoroughly washed it is impossible to have a mixture of two or cispltin adsorbed onto external surfaces of vaterite particles. Hence cisplatin is encapsulated within the hollow nanoparticles of vaterite. This product has a significant medicinal use as a safe anticancer drug since the cytotoxicity of cisplatin can be drastically reduced in this way.

Bio assay guided isolation of anti-bacterial active compounds from whole plant extract of *Eleusine indica*

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Development of new antibacterial compounds is highly important to overcome the problem associated with the rapid increase in the rate of infections, development of antibiotic resistance in microorganisms and side effects of synthetic antibiotics. In this regard, use of medicinal plants is becoming dominant as they have minimum side effects and low resistance to microorganisms. The aim of this study was to evaluate the antibacterial activity of the plant *Eleusine indica*, a widespread weed which is commonly referred to as Belathana in Sri Lanka and widely used as a medicinal plant for the treatment for sprains, dislocations, liver disorders, dysentery, convulsions, coughs, malaria etc. in ayurveda medicine. A detailed study was performed on the antibacterial activity of dichloromethane (DCM), ethyl acetate (EtOAc) and methanol (MeOH) extracts of whole plant against the **G**ram positive bacteria Staphylococcus aureus, methicillin resistant Staphylococcus aureus (MRSA) and **G**ram negative bacteria Escherichia coli using agar disk diffusion method. Only DCM extract of the plant showed antibacterial activity against S.*aureus and E.coli*. None of the extracts showed antibacterial activity against MRSA. The MIC values for the DCM extract were determined by agar plate dilution assay against bacterial isolates *S.aureus, E.coli* and MRSA. The MIC values obtained for *S.aureus* and *E.coli* are 900 ppm and 1024 ppm, respectively.

The dichloromethane extract of *E. indica* was subjected to bio assay guided fractionation using medium pressure liquid chromatography (MPLC), using solvent combinations of increasing polarity of hexane, ethyl acetate and methanol. From the column separation, 287 fractions were collected and thin layer chromatography was performed. Based on the TLC pattern, 11 fractions were obtained on combination of appropriate separations and the combined fractions were tested for the antibacterial activity against *S.aureus* using agar disk diffusion method. Only 3rd and 4th combined fractions showed antibacterial activity and these fractions were further separated using flash column chromatography and by observing the TLC patterns, 4 fractions were obtained on combination of appropriate separations. These obtained fractions were tested again for the antibacterial activity against *S.aureus* and only combined fractions 1 and 2 showed activity. The fractions were subjected to column chromatography and the active compound was isolated and tested for the antibacterial activity. Structural characterization is in progress and ^{1}H-NMR data showed the presence of double bond and OCH_2/OCH_3 groups. This study reveals that the weed plant *E. indica* possesses strong antibacterial activity and isolated active compound would be able to use as potential antibiotic drug candidate, which can be further modified for the improved activity. Future studies will be focused on the structure elucidation of the active compound and structural modifications for the higher activity.

Inspectional analysis to produce graphene oxide using Sri Lankan natural vein graphite

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Sri Lankan vein graphite has remarkable properties that can be used in different technological applications such as energy conversion, nanotechnology etc. Especially, the graphene oxide (GO), that is used for many advanced nanotechnological applications, can be produced using Sri Lankan vein graphite. In this study, GO was synthesized using highly purified Sri Lankan natural vein graphite. However, instead of employing typical Hummer's synthesis method with a single oxidizing agent of $KMnO_4$, a mixture of $KMnO_4$ and $K_2Cr_2O_7$ oxidizing agents was used for this study. The main objective was to obtain different levels of interlayer expansion in graphene oxide. The synthesized GO was characterized by X-ray Diffraction (XRD), micro-Raman spectroscopy and Scanning Electron Microscopy (SEM) techniques. The XRD phase analysis clearly showed the expansion of the interlayer distance of graphite from 3.34 A^0 to 7.46 A^0 after synthesizing to GO. The higher d-spacing in GO could result due to lattice expansion and intercalation of oxygen-containing functional groups to the graphite lattice. Interestingly, this interlayer spacing 7.46 A^0 is considerably different to that reported by ordinary Hummer's method (0.86 nm), The SEM analysis showed that the oxidized graphite has exfoliated into several layers forming porous networks that resemble a loose sponge-like structure. Further, the micro-Raman analysis confirmed that I_D/I_G ratio increases with the oxidation of graphite. The average crystallite size of sp^2 domain calculated was 21.36 nm for chemically oxidized GO. However, the crystallite size decreases with increasing degree of oxidation, which associates with the breaking of crystallites resulting in the formation of defects, vacancies, and distortions. Altogether, this study showed the capability to synthesize graphene oxide from Sri Lankan natural vein graphite by the method used in this study. Furthermore, the finding of this study can be useful to produce expanded graphite with different interlayer spacing.

Pickering emulsions stabilized by a non-ionic surfactant and assorted metal oxide nanoparticles

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Pickering emulsion is an emulsion stabilized by solid particles in place of surfactants as the emulsifier. Stabilization of emulsion droplets takes place by means of adsorption of solid particles at the surface of the emulsion droplets. Solid particles are not amphiphilic like surfactants. Thus the stabilization mechanism is very different from surfactants. Partial wetting of the surface of the solid particles by water and oil is the origin of the strong anchoring of solid particles at the oil-water interface. There are numerous potential applications of Pickering emulsions. These are used in cosmetic industry, food applications and in pharmaceutical industry for drug delivery purposes.

A ternary phase diagram was used to select formulations of unstable emulsions. The three components in the phase diagram are Olive oil, water and the surfactant- Span 80. It has been shown in a previous study that Magnesium Oxide (MgO) nanoparticles successfully stabilized micro emulsions. In our study Zinc Oxide (ZnO) nanoparticles were synthesized using a Sol-gel process. Commercially available Titanium dioxide (TiO_2) nanoparticles were taken for this purpose. Using the ZnO and TiO_2 nanoparticles, the morphologies of the resulted Pickering emulsions were studied and compared with the emulsions formed with MgO.

The key main conclusions of this work are that different metal oxide nanoparticles can be used as stabilizers of Pickering emulsions. MgO nanoparticle has the ability to convert an unstable emulsion into a stable micro emulsion, whereas ZnO and TiO_2 have the ability to form macro emulsions. The increasing order of particle size of metal oxide nanoparticles are 25, 70 and 100 nm for TiO_2, MgO and ZnO respectively. Particle size is one factor that determines the stability of emulsions. Moreover the chemical interactions between the solid surface and the two liquid phases, which ultimately determine the contact angle mainly affect the stability of emulsions.

Bioassay guided isolation of active compounds from hexane extract of fruits of *Garcinia quaesita* pirre

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Search for potential plant based anti-cancer agents is a high priority in the scientific research in natural product chemistry as a treatment for cancer. Among many reasons, cancer can be a result of an oxidative stress. Use of wide variety of anti-oxidants is considered as the preventive mechanism for the rapid generation of free radicals as well as the reactive oxygen species to minimize the risk of degenerative diseases and cancer. The aim of the current study is to isolate antioxidant compounds from the fruits of *Garcinia quaesita, w*hich is endemic to Sri Lanka and is commonly used as a food preservative. The studies carried out on the antioxidant activity using DPPH radical scavenging assay, and the cytotoxicity (brine shrimp (*Artimea salina*) lethality assay) of hexane (GH), ethyl acetate (EtOAc, GE), methanol (MeOH, GM) extracts of dried fruits of *G. quaesita* showed that the GH possessed remarkably high anti-oxidant activity with a IC_{50} of 8.74 ppm compared to that of the positive control (α-tocopherol, IC_{50} 13.46 ppm) and cytotoxicity with LC_{50} values of 0.45 ppm compared to that of the positive control ($K_2Cr_2O_7$ LC_{50} 35.78 ppm). However, reports on the higher anti-oxidant activity as well as the cytotoxicity on the hexane extract of *G. quaesita* are absent in the literature and hence the isolation of active compounds was done for the GH.

Medium pressure liquid chromatography (MPLC) was performed for crude GH using solvent combinations of increasing polarity of hexane to ethyl acetate. The resulting column fractions were analyzed using Thin Layer Chromatography (TLC) and based on the TLC pattern, 9 fractions were obtained combining the appropriate separations and then the combined fractions were subjected to the TLC autography with DPPH as the spraying agent. Only the 5th combined fraction showed anti-oxidant activity and it was further separated using flash column chromatography and by observing the TLC patterns, 2 fractions were obtained. These obtained fractions were subjected to the TLC autography with DPPH as the spraying agent where only the 2nd combined fraction showed activity. Two compounds were isolated from the 2nd fraction after subjecting to column chromatography, which was tested for anti-oxidant activity. The crystalline compound, which showed strong anti-oxidant activity, was further subjected to the DPPH assay and it showed anti-oxidant activity with an IC_{50} value of 0.2486 ppm. The FRAP value obtained for the pure compound was 740 μmol Fe(II) equiv/g extract compared to that of L-ascorbic acid (2260) which showed correlations of DPPH and FRAP assay with a $R^2 = 0.971$. Further, the pure compound showed very high cytotoxicity (LC_{50}= 2.0471) comparable to $K_2Cr_2O_7$. These data revealed that the pure compound isolated from GH has higher anti-oxidant activity and cytotoxicity, which would be a probable target for the anti-cancer studies. Structure elucidation of the pure compound is currently in progress and future studies will be focused on anticancer activities.

Raptors presented to Veterinary Teaching Hospital (VTH), University of Peradeniya

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Forty three raptors, (19 eagles and 24 owls) belong to seven species were presented to the Veterinary Teaching Hospital, University of Peradeniya over a two and a half- year period (January 2014 to June 2016).Three species of eagles namely, Crested serpent eagle (*Spilornis cheela*) (13), Changeable hawk-eagle (*Nisaetus cirrhatus*) (5) and Brahminy kite (*Haliastur indus*) (1); and four species of owls namely, Oriental Scops owls (*Otus sunia leggei*) (10), Brown wood owl (*Strix leptogrammica*) (11), Brown fish owl (*Bubo zeylonensis*) (2) and Spot-bellied eagle-owl (*Bubo nipalensis*) (1) were the raptors presented.

General clinical examination after careful handling and restraint was performed upon arrival at the VTH and appropriate samples were collected. Specific treatment and management protocols were designed and executed for each raptor depending on the diagnoses. A primary clinical diagnosis was made in 38 (88.6%) and no diagnosis was made in 5 (11.6%) raptors admitted. Twelve birds (27.9%) were orphaned juveniles and all these were owls (Oriental Scops owls- 9, brown wood owls – 2, Spot-bellied eagle-owl -1). Traumatic injuries were recorded in 19 animals including an orphan owl. The types of injuries were fractures (11), ocular trauma (2) and other injuries (5). Most of the fractures were open, infected and infested with fly larvae at the time of presentation. The remaining animals were diagnosed as having infections (2), poor nutrition (5), and corneal opacity (1). Causes for traumatic injuries were unknown for majority of cases (73.6%) while there were two cases of animal attacks, two cases of electrocution and one case of vehicular accident. An external parasite, brown chicken louse (*Goniodes dissimilis)* was found in 8owls and the presence of heamoparasite , *Haemoproteu spp.* was detected in 6 owls.

Overall, 18 (41.9%) died, 13 (30.2%) ended up in permanent captivity while 12 (27.9%) were released back to the wild. A satisfactory survival rate (75%) was recorded among orphaned baby raptors. This preliminary investigation on raptors as wild animal patients highlighted some of the clinical problems and outcomes of treatment and management of these animals.

Antioxidant activity in aqueous extracts of fruit of *Phyllanthus emblica* stored for six months at room temperature and at 4ºc using 1, 1- diphenyl-2-picrylhydrazyl (dpph) assay

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Free radicals contribute to more than one hundred disorders in humans including atherosclerosis, arthritis, and ischemia reperfusion injury of many tissues, central nervous system injury, gastritis, cancer and AIDS. Human bodies protected from oxidative damage of free radicals through some complex defense systems, which are called antioxidants. The objective of this study was to evaluate the antioxidant activity of the fruits of *Phyllanthus emblica.* The cold and hot extracts obtained from the powder of *Phyllanthus emblica* were stored at room temperature (37^0 C) and at 4 º C in monthly interval for six months. The free radical scavenging off fruits of *Phyllanthus emblica* extracts evaluated by DPPH assay according to the method described by Blois (1958). The absorbance measured at 517nm with uv- vis spectrophotometer .The initial Total Anti-oxidant Capacity (TAC) of cold and hot water extracts IC 50 values were 17.8, 14.1 µg/ml dry weights respectively. When the powder was stored at room temperature for a month and the TAC was analyzed, the cold and hot water extracts contained IC 50 value 29.9 24.41 µg/ml dry weight respectively. TAC of cold and hot water extracts contained IC 50 value of 240.1,188.1, µg/ml dry weight respectively, when the powder was stored at room temperature for 6 months, while the TAC of cold and hot water extracts of the *Phyllanthus emblica* powder stored at 4ºC for six months respectively IC 50 values were 209.5, 163.1 µg/ml dry weight. Extraction of antioxidant activity was better with hot water than with cold water. When compared with the cold extracts, hot extracts contained higher DPPH radical scavenging activity. DPPH radical scavenging activity was retained better at 4ºC than at room temperature. DPPH radical scavenging activity decreased with the storage period at both temperatures, but the decrease in DPPH radical scavenging activity was higher at room temperature than at 4ºC.This study showed that the *P. emblica* powder could be used for 'Chooranam' preparation immediately after the preparation of the *P. emblica* powder.

Characterisation of *Rhizobium sp.* in *Cletoria ternatea* L. from five different districts of Sri Lanka

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Legume plants have the ability to fix atmospheric nitrogen symbiotically with the association of *Rhizobium* that inhabits the root nodules. *Cletoria ternatea* L. is a legume, which grows naturally in dry and less fertile lands. It has the ability to fix nitrogen even under harsh environmental conditions. The present study was aimed at screening the Rhizobial strains of *Cletoria ternatea*L which have the ability to tolerate high salinity, high temperature, drought, and a broad pH range and, identifying and differentiating the best tolerant strains at molecular level using PCR amplified Enterobacterial Repetitive Intergenic Consensus (ERIC) profiling. Bacterial colonies were isolated from root nodules, which were collected from five different districts of Sri Lanka, namely, Jaffna (J), Trincomalee (T), Vavuniya (V), Mannar (M) and Kandy (K). Fresh nodules were collected and pure cultures were obtained by using ½ Lupin agar medium. Total of 25 pure colonies representing the five districts (5 from each district) were selected. These cultures were grown in ½ Lupin broth ranging the temperature from 25℃ to 60℃, NaCl concentrations 1-5%, pH from 2-10, and PEG from 10-30%, separately. Growth of the cultures was tested by measuring the optical density at 600 nm. From physiological characterization, fourteen best high tolerant strains were selected for ERIC profiling. Among these 14 isolates, M3, and V3 isolates exhibited good tolerance to the temperature range from 25℃ to 60℃, NaCl concentration range from 1-5%, pH range from 2-10 and PEG concentration 10-30%. The isolates J1, T1, K1 and K3 were tolerant to the same temperature range, salinity and pH conditions. J2 and K3 exhibited high tolerance to 30%PEG concentration. Out of 14 stress tolerant isolates, we were able to distinguish 5 different banding patterns using PCR amplified ERIC profiling. The high tolerant M3 and V3 were showing different polymorphic banding patterns suggesting that they are different strains. These high tolerant strains can be used for cross inoculation with commercially important legume crops to improve their yield under harsh environmental conditions and for bio fertilizer production.

A preliminary study on impacts of *Bambusa bambos* spread in intermediate zone forests in Moragahakanda, Sri Lanka

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Bambusa bambos is native to Sri Lanka though it is a known invasive species elsewhere in the tropics. Some parts of the intermediate zone forests in Moragahakanda area (located in the Matale district) have been heavily invaded *by B. bambos*. The present study was carried out to identify some ecological impacts of this invasive spread in these forest ecosystems by comparing an invaded (INV) and an un-invaded (UNI) forest patch, located about 2 km apart from each other. The vegetation less than 1 m in height (hereafter will be known as ground vegetation) was enumerated using ten, randomly placed 1 m^2 quadrats. Seedling richness, density, diversity and evenness values were calculated. Surface litter was quantified. Soil samples were analyzed for some basic soil parameters including pH, conductivity, moisture content, microbial biomass carbon, total nitrogen and phosphorus. The results were analyzed using Minitab 16.0 version. The ground vegetation in INV forests showed higher density and species richness compared to UNI forests. The Shannon-Wiener Diversity index (H') also showed a higher value in INV (2.77) than in UNI forests (2.03). The Pielou's Evenness index also recorded a higher value at INV (0.82) compared to UNI (0.60). The abundance of tree saplings and seedlings was also higher in INV than in UNI forests. Species composition showed notable differences between INV and UNI forest patches, with only two species in common. Though the surface litter was dominated by *Bambusa* litter ($\approx$ 86%) in INV forests, the total litter content did not differ significantly between the two forest patches. Soil analysis revealed significantly higher N, P and moisture contents in INV sites than in UNI. Microbial biomass C too showed higher values in invaded forests, though not significantly. The preliminary results suggest that *Bambusa* spread has changed the composition of the ground vegetation with a possibility of altering the standing vegetation over time. *Bambusa* spread seems to enhance the soil fertility status perhaps through higher litter turnover and its quality. The preliminary results suggest that the *Bambusa* spread has the potential to alter these intermediate zone forests unless measures are taken to control its spread.

Nutrient-use efficiency of epiphytes, hemi-parasites and their hosts

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Epiphytic and hemi-parasitic species are a major constituent in tropical forest ecosystems and influence nutrient cycling. However, internal use efficiency of nutrients such as, nitrogen (P), phosphorus (P), potassium (K), calcium (Ca) and sodium (Na) of the host species, and epiphytic and hemi-parasitic species inhabited on those host species in Sri Lanka is not well understood. Therefore, this study was conducted using the senesced and green leaf samples collected from the host, epiphytic and hemi-parasitic species. There were twenty three epiphytic species, eight hemi-parasitic species and their hosts collected from selected natural forests in Nuwara-eliya, Peradeniya, Ratnapura and Matale regions. Leaf samples were taken to the laboratory for nutrient concentration, leaf area, and dry weight determinations. Differences in nutrient concentrations among plant types were tested using ANOVA procedure. Relationships between the nutrients and plant types were studied using regression and correlation analyses. Nitrogen, Ca and Na concentrations of the host species were positively correlated with those of hemi-parasites while for epiphytes such relationships were not observed. Nutrients were resorbed from senescing leaves with the highest N resorption percentage observed from the host species while the highest K, P, Ca and Na resorption occurred from the senescing epiphyte leaves. Therefore, epiphytes show the highest nutrient recovering mechanisms compared to hosts or hemi-parasite species.

Variation of *Lasiaspinosa* (L.) Thw. (*kohila*): an underutilized aroid with high potential in Sri Lanka

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Lasiaspinosa (L.)Thw. is considered as a high potential indigenous aroid in Sri Lanka. Though it is rich in medicinal and nutritional properties, *L. spinosa* is not popular among consumers and farmers as other vegetable crops. Though Sri Lankan *Lasia* population shows a wide range of morphological variation, it has not been properly studied and documented. Morphological characterization is considered as the first step prior to in-depth biochemical or molecular studies. Therefore, this study was conducted to assess the diversity of *L. spinosa* found in 18 agro-ecological regions in Sri Lanka. Morphological characters were observed, measured and documented at the field according to a list of descriptors. Selected chemical parameters (moisture content, nitrogen, phosphorous and potassium concentrations and crude fiber concentration) were measured using standard laboratory techniques in both immature leaves and rhizomes at the level of edible/ harvestable stages. A survey was conducted among Ayurvedic practitioners to document medicinal uses of *L. spinosa.* Data were analyzed using hierarchical cluster analysis and univariate procedures. Ninety accessions were collected from Sri Lanka. They were grouped in to four main clusters based on leaf characters (sagittate type, lamina dissected type, mixed form and *kalu-kohila*) and several sub clusters. The study was able to discover a spineless *L. spinosa* type and it was grouped under sagittate type. Apparently *kalu-kohila* could be a rare local form of *L. spinosa* and historical records revealed that it was used in the indigenous medicine. In the chemical analysis nitrogen, potassium, crude fiber and moisture content showed significant differences ($P<0.05$) among four types, but phosphorous concentration was similar in rhizomes. Compared to others, spineless type showed significantly higher values for chemical properties studied. The different uses of *L. spinosa* in ayurvedic medicine were also documented. The spineless type and *kalukohila* can be considered as superior germ plasmin future crop improvement programs.

PAPER NOT PRESENTED

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Occurrence of serine protease inhibitory activity in the bark extract of *Entada pursaetha*

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Serine proteases carry out a diverse array of physiological functions and incorrect regulation of expression of serine proteases lead to many disease processes including cancer, renal diseases, neurodegenerative disorders. Serine protease inhibitors have become a target in the treatment of many such disorders leading to numerous investigations of the natural serine protease inhibitors. Members of the family Fabaceae are well known to contain serine protease inhibitors. Thus, the current study was aimed at identification and characterization of serine protease inhibitors from *Entada pursaetha* of the family Fabaceae.

An assay procedure was developed and optimized to determine the serine protease inhibitory activity of the aqueous mature bark extract of *Entada pursaetha.* For the assay procedure, trypsin was used as the serine protease and casein as the substrate. Dialysis was performed by using a membrane of 14 kDa molecular weight cut off point followed by ion exchange chromatography and ammonium sulphate precipitation to purify the serine protease inhibitors in the crude extract. Thermal stability of serine protease inhibitory activity of the crude extract and partially purified sample was determined by incubating them at 37 ^{0}C and 60 ^{o}C for one month.

Optimum pH for the inhibitory activity was pH 7.6 and 10% bark extract resulted in a 50.24% inhibitory activity. Dialysis with 14 kDa membrane increased the remaining inhibitory activity to 149.62%. Thus, it can be concluded that inhibitory molecules are macromolecules with molecular weight greater than 14 kDa. Thermal stability studies revealed that the inhibitor molecules are thermally stable. Partial purification of the protease inhibitors was achieved by anion exchange chromatography (pH 7.6, 8.5), cation exchange chromatography (pH 7.0, 5.5 and 5.0) and ammonium sulphate precipitation. This assay procedure provided the quantitative measurement of the inhibitory activity for the inhibitor/s present in the crude bark extract. The bark extract may contain both proteinaceous and non-proteinaceous serine protease inhibitors. Further studies on purified inhibitors are necessary in order to characterize and to elucidate the structure/s of the inhibitors.

Morphological and molecular characterization of *Colletotrichum* causing anthracnose in ripe avocado (*Persea americana* Mill.)

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Anthracnose is a major disease in ripe avocados (*Persea americana* Mill.) worldwide which, while limiting the shelf life and marketing potential, incurs significant fruit losses. Avocado anthracnose has long been believed to be caused by *Colletotrichum gloeosporioides* and *C. acutatum,* both of which are presently regarded as species complexes, comprising many closely related species. *Colletotrichum* was isolated on PDA, from anthracnose lesions in twenty ripe avocados collected in Sri Lanka. Morphometric analysis, using eleven characters including colony, conidial and appressorial morphology, divided the twenty isolates into two main clusters. The conidial size has largely contributed to cluster separation. All the twenty isolates were subjected to DNA sequence analysis using internal transcribed spacer (ITS), β-tubulin 2 (TUB2) and glyceraldehyde-3-phosphate dehydrogenase (GAPDH) regions. Species affiliations and identities of the resulting sequences were determined through similarity-based searches of the NCBI GenBank Database. Considering >96% similarity in the three gene regions, nine and eleven isolates were identified as *C. siamense* and *C. endophytica* respectively, both belonging to the *C. gloeosporioides* complex. This is the first report of association of *C. endophytica* and *C. siamense* with avocado anthracnose. ITS region contributed in placing the taxa within *C. gloeosporioides* while TUB2 and GAPDH have successfully resolved their identity to species level. The results of multivariate statistical analysis did not agree with the molecular sequence analysis hence the present study has also shown that the morphological characters are not reliable for identification of *Colletotrichum* up to species level. The information that the present study has unveiled would help rectify the incorrect and insufficient understanding of the *Colletotrichum* species causing avocado anthracnose in Sri Lanka. This will also encourage design of similar identification techniques for determination of anthracnose pathogens in other fruit types in Sri Lanka. Moreover, accurate identification of the causal organisms is vital for designing meaningful disease management strategies.

Assessing the impact of stabilized urea on nitrogen use efficiency of irrigated rice (*Oryzasativa* L.)

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Agronomic efficiency of N (AE_N) in rice cultivation ranges from 15 to 40 % due to heavy losses of applied N. Dicyandiamide (DCD) and N-(n-butyl) thiophosphorictriamide (NBPT) are used for some crops to enhance the efficiency of urea fertilizer and to reduce ammonia volatilization, respectively. The DCD and NBPT were evaluated in combination with different levels of the recommended rate of urea by the Department of Agriculture (DOA), Sri Lanka to examine the AE_N in irrigated rice (*Oryzasativa*L.) conducting a field experiment at the intermediate zone (Palwehera, CIC farm). The experiment was a two factor factorial where factors were N fertilizer with three levels (50%, 75% and 100% of the Department of Agriculture (DOA) recommended rates (225 kg Urea/ha)) in the form of urea, and inhibitor compounds with four levels (no inhibitors, only NBPT, only DCD and combination of NBPT + DCD) and a control of no N fertilizer added, arranged in a Randomized Complete Block Design (RCBD) with three replications. The DCD and NBPT rates were 10 % and 1 % of the amount of urea used, respectively. Results showed an 11 % yield and 2.38 fold AE_N increments in 50 % urea applied treatment with both inhibitors, compared to 100 % urea without inhibitors (3.83 mt/ha; $AE_N$of 21%).Grain protein content was 20 % higher in DCD-amended urea compared to urea alone. Benefit: cost ratio was the highest when 50 % urea was amended with NBPT (9 % yield advantage than 100 % urea alone). Thus, application of urea with DCD and NBPT alone or in combination leads to a significant increase in grain yield and AE_N while reducing the amount of urea application to an half.

Impact of training on home gardening: the case of Sri Lanka Hadabima Authority

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Farmers are more likely to adopt new technologies and become more productive with the help of basic education, training and extension service. Sri Lanka Hadabima Authority, specially trains farmers to develop small business operations of home gardening and conducts three-year follow up program on home gardening development. This research examined how home gardening training influences the development of skills and knowledge of the home gardening farmers. We interviewed 120 trainers from Rattota and Ukuwela areas in Matale District, Gampola in Kandy District, and Wijayapura in Anuradhapura District, who followed the home gardening training program in Hadabima Authority, using semi-structured questionnaire. Field visits were made to observe home gardening practices. The data was gathered on the basis of importance, content and applicability of the training, opportunity to transfer and post training intervention. Pre and post tests were conducted to measure knowledge, skill and attitudes on Home Gardening Training Program. The major findings of the study revealed that the majority of trainers have improved their skills, knowledge and attitudes after the training program. There was a significant difference between pre-test and post-test (P<0.01) indicating that knowledge and skills had been gained through the training program. The field visits confirmed that the training was useful to implement Best Management Practices (BMPs) in home gardening among participants. For Example, 30% of participants have grown more than 10 plant varieties (fruits and vegetables) in their gardens, 24% maintained compost fits, 23% retained cultivation ladders, 15% maintained product diversification (plants, animals, and mushroom) and 8% maintained sales outlets. With the increased land size, there was a high potential of applying the BMPs suggested by the training. The trainees, who had positive attitudes of posttest, had higher tendency to apply BMPs after six month training. With the increase of education level of respondents final productivity also increased in a positive manner. In conclusion, training, evaluation and follow-up process are useful to get an idea as to which extent they had knowledge, skill and positive attitudes before the training and, how these have improved after the training.

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Impact of seed variety and seed roasting on physicochemical and sensory properties of cold-pressed sesame oil

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Cold-pressed sesame oils were expelled from single origin varieties of white (*Uma*) and black (MI-1) sesame seeds, commercially available varieties of white (CW) and black (CB) sesame seeds, roasted CW and roasted CB, in triplicate, using a domestic screw-type expeller (DL-ZYJ02, Dulong, China). Seed roasting was done in a natural convection oven (DS-63, Yamato, Japan) at $133\pm3°C$ for 20 min. The measured temperatures of the oils being expelled varied in the range of 40 to 50°C. Sesame oils so produced were allowed to clarify by gravity settlement of particles, and then assessed for yield and selected physicochemical and sensory properties.

Moisture content (MC), estimated by Karl Fischer titration, and refractive index (RI) and free fatty acid (FFA), estimated according to Sri Lankan Standards (SLS) methods, of all oil samples complied remarkably well with SLS and CODEX standard. Total phenolic content (TPC) of the oil and oil yields varied significantly among the seed varieties. Extinction coefficients at 232 nm (K_{232}) and 270 nm (K_{270}), estimated according to SLS method, also differed with seed variety. Oils obtained from commercial seed varieties had higher K_{232} and K_{270} values when compared with the oils obtained from single origin seed varieties. K_{232} and K_{270} values are said to indicate the levels of conjugated dienes and trienes which are products of oil oxidations. It is also plausible that they indicated the presence of beneficial lignans in sesame oil, a hypothesis yet to be verified. Sensory evaluation results showed that color, odor and flavor of the oils produced from white seed varieties (U*ma*, CW) were preferred to those produced from black seed varieties (MI-1, CB).

Roasting of commercial seed samples caused significant reduction in yield and MC of oil and no significant changes in RI, FFA and TPC. Roasting of CB seed samples increased K_{270} of the oil produced. Roasting affected positively on the flavor of the oils, but it led to reduced preference for odor and color.

This study demonstrates the potential to produce virgin sesame oil confirming to the globally accepted standards using locally available sesame seed varieties under controlled conditions.

High quality compost production using waste from coco-peat manufacturing process

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Composting of waste coir pith together with other agricultural by-products and green manure such as foliage and stem parts of banana and *Gliricidiasepium*, moistening with the effluent from the coco peat manufacturing process was compared with standard composting protocol with respect to production quality and cost of production. The compost recipes were formulated based on the C: N ratios of the ingredients (raw materials). Composting was carried out by sequential layering of coir pith with other ingredients. Treatment 1-3 contained all the ingredients in different ratios while treatment 4 (control) did not contain coir pith as an ingredient. Composting treatments 1-3 were wetted with the effluent solution from the coco-peat processing factory while treatment 4 was treated with water, maintaining the moisture content of the sample heaps at 50-60%. The final compost quality was measured in terms of organic C, total N, P, K, Ca and Na contents, pH value and C: N ratio.

Composting formulae were analyzed sequentially and the final analysis was done in six months' time, the standard composting period. Standard protocol, which did not contain coir pith (Treatment 4) had a significantly higher ($p \leq 0.05$) pH value of 8.20 at the end, compared to other treatment combinations where pH was at the range of 7.15 - 7.39. Carbon content was in a decreasing trend during the time of composting in all the treatments, ending-up at 13.36– 22.74%. The total N content of the compost ranged between 1.89- 2.34%. At the end of composting process, the C: N ratio of different composting formulae did not differ significantly and it ranged within 7-10:1. Except Treatment 3, all other treatments showed fairly high K contents and Ca contents, satisfying the Sri Lankan standards for composts. However, the mean P contents were slightly below the standards in all treatments. With respect to the final compost quality, treatment 1 and treatment 2 were not significantly different in terms of the most of the parameters tested. Accordingly, the materials used and procedure practiced in treatment1 could be identified as the most appropriate for producing high quality compost which is comparable with the national standards.

Abstract No: 196   *Plant Sciences and Forestry*

Characterization of a new tea (*Camellia sinensis*) hybrid progeny based on SSR markers and morphological traits

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Hybridization is the main method for creating genetic variation and breeding new cultivars in tea (*Camellia sinensis*) which is vegetatively propagated. To add variations to existing tea germ plasm, 118 putative hybrids of tea were generated from crossing two diverse parents, TRI2043 which is characterized with high pubescence density, pigmented leaves, resistance to blister blight disease, production of silvertips and higher yield, and TRI3055 a non-pigmented stem, canker resistant cultivar with less leaf hairs. A reciprocal cross also was made. The total progeny was characterized for five morphological traits; anthocyanin pigmentation in petiole, leaf vestiture, average number of pubescence of leaf, immature leaf colour, and petiole colour following IPGRI and UPOV guidelines for tea. Using these data, a dendrogram was constructed based on Nei's genetic distance analysis by using the software "Tree view" version 1.0.

Average number of pubescence in lower surface of the second leaf varied from 5 to 149 per 7.0174 mm^2 with a mean of 62. Parental cultivar TRI2043 recorded the highest average number of pubescence and TRI3055 had the lowest. Among the progenies, 93 individuals contained anthocyanin pigmentation in petiole which is the characteristic feature of silvertip producer TRI2043. The degree of pigmentation and the intensity of the leaf colour varied among hybrid progenies. In the morphological dendrogram, progenies were grouped into four different clusters. Forty individuals showed close resemblance with the parent TRI2043 and 21 individuals were grouped with cultivar TRI3055. Rest of the individuals shared both parental morphological characteristics which show economically important qualities.

Based on the morphological diversity 42 individuals were selected and subjected to molecular genotyping using four tea specific SSR primers. A total of 24 alleles were generated ranging from 120 to 400 bp. In the molecular clustergram, eighteen progenies were grouped with the parent TRI 3055 and the rest of 24 with TRI2043.The hybrid progeny 100 strongly resembled the parent TRI 3055while the hybrid progeny 57 strongly resembled the parent TRI 2043.

There were discrepancies between morphological and molecular clustering. Tea progenies in matching clusters between the two schemes can be reliably deployed in future breeding programmes.

Abstract No: 203 *Plant Sciences and Forestry*

Diversity analysis of leaf vein density of selected Sri Lankan rice varieties: an indicator of C_3 to C_4 photosynthesis pathway transition

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Out of the commonly cultivated cereals in the family *Poaceae*, maize and sorghum follow a C_4 photosynthetic pathway, while rice and wheat follow a C_3 pathway. Hence, carbon assimilation of C_3 is lower compared to C_4 plants. Studies revealing the evolution of these photosynthetic pathways indicate that C_4 plants evolved from C_3 plants. The transition is demarked by increased leaf vein density and subsequent cellular compartmentalization that facilitate efficient carbon fixation. In a leaf, photosynthates from nearby cells are collected by small longitudinal veins, transverse veins and large longitudinal veins, and are translocated out of the leaf *via* the phloem. Hence, with a denser leaf vein density, the translocation process is expected to be more efficient.

In the current study, longitudinal leaf vein (LV) density of 12 selected rice varieties was measured to assess their diversity with respect to collective assessment of both small and large LV density. The total LV length per unit area (TLV) and the average distance between LV (ADLV) were measured in a one-cm leaf sample fixed in a permanent slide, made from the widest middle portion of the first leaf of the main culm. The sections were imaged and the distances were measured using DinoCapturev2.0. The TLV and ADLV of the selected varieties wereanalysed using a one-way ANOVA with PROC GLM, and mean separation was carried out using Duncun's multiple range test in SAS v9.1.3.

A significant negative correlation was observed between TLV and ADLV ($r = 0.969$, $p < 0.05$). Among the selected rice varieties, *Dewareddhiri* and *Madayalvee* have the highest TLV (5.7 ± 0.1 and 5.6 ± 0.1 mm/mm^2 respectively) and the lowest ADLV (159.6 ± 1.2 and 160.8 ± 3.3 μm, respectively). The variety *Moroberekan* shares the lowest TLV with *Pachchaperumal*, and *Sivappukuruvikkar* (4.8 ± 0.1, 4.8 ± 0.1 and 4.6 ± 0.1 mm/mm^2, respectively) and *Moroberekan* has the highest ADLV (195.3 ± 4.0 μm). The high TVL and low ADLV denote a high leaf vein density. Thus, the high vein densities of the varieties *Dewareddhiri* and *Madayalvee* could be a possible indicator of transition from C_3 to C_4 photosynthetic pathway. Further, analysis of these varieties with respect to leaf anatomy is underway.

Molecular phylogeny and species limits of native *Asparagus* in Sri Lanka

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Asparagus L. commonly known as "Hatawariya", is the type genus of the family *Asparagaceae* and is distributed in moist, dry, intermediate and montane regions of Sri Lanka. Throughout the taxonomic history the circumscription of the genus has been changing. In 1898 Trimen recognized four species of Asparagus occurring in Sri Lanka, A. racemosus Willd., *A. zeylanicus* (Baker) Hook f., *A. falcatus L. and A. gonoclados* Baker. In 2000, Dassanayake recognized only three species, where he merged *A. zeylanicus* with *A. racemosus*. A morphometric analysis carried out recently on Sri Lankan Asparagus recognized five phenetic groups within the genus, where *A. racemosus* was divided into three distinct phenetic groups; low country, small cladode bearing group; low country, large cladode bearing group and upcountry, small cladode bearing group. Therefore, the present study was carried out to determine the species limits and phylogenetic relationships of native Asparagus species occurring in Sri Lanka, using molecular sequence data and also to study their seed characters. The molecular phylogenetic analyses were carried out using internal transcribed spacer (ITS1-5.8S-ITS2) region of the nr (nuclear ribosomal) DNA and chloroplast DNA petD-rpoA intergenic spacer region independently and in combination. This also included a combined molecular and morphological analysis. Seed shape and sculpturing patterns were studied using the Scanning electron microscope and were included in the combined molecular and morphological analysis. Phylogenetic tree based on the combined molecular DNA sequences suggests the monophyly of the native Asparagus species. In all the phylogenetic analyses the low country, small cladode bearing A. racemosus group was recovered as the basal group, and this phenetic group best matched with the morphological description in taxonomic literature for *A. racemosus*. Combined molecular and morphological analysis revealed the close relationship of upcountry *A. racemosus* group with *A. gonoclados* and the distinctiveness from the other two phenetic groups. This group corroborates with previously described *A. zeylanicus* (Baker) Hook f. in literature. The present study suggests the necessity of the resurrection of the endemic *A. zeylanicus*. Furthermore, the identity of the low country, large cladode bearing *A. racemosus* group needs to be supported by further studies.

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Comparative surface morphology of two rice blast resistant and susceptible rice varieties

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The rice blast fungus *Magnaporthe grisea* causes one of the most destructive fungal diseases in cultivated rice throughout the world. The contribution of surface morphology on disease resistant development is a well-known fact. Although surface morphological analyses are performed, no recent studies were done to develop morphological markers to distinguish blast resistant and susceptible varieties. Therefore, the present study was conducted to identify and compare the surface morphology of resistant (Tetep) and susceptible (Pachchaperumal) rice varieties to rice blast disease and to understand the effect of surface morphology on development of resistance against blast pathogen. Micrographs of upper and lower surface of leaf and stem of both varieties were taken under 250X and 500X magnifications using a scanning electron microscope (SEM) with energy dispersive X-ray spectroscopy. Surface morphology of Pachchaperumal and Tetep was compared and fine structures on the surface were identified using SEM images with 250X and 500X magnifications, respectively. Surface hair densities were calculated through direct observations using a grid. On adaxial surface of Pachchaperumal, macro-hairs arranged with a mean density of 53.00 cm^{-2}. Instead Tetep had silicified prickle hairs (277.50 cm^{-2}). In Pachchaperumal unicellular macro-hairs were scarcely observed (1.00 per 3 cm^{-2}) but unicellular macro-hairs were absent on Tetep leaf abaxial surface. Only Tetep had prickle hairs (53.66 cm^{-2}). Macro-hairs were present on the stem surface of Pachchaperumal, (361.00 cm^{-2}), while Tetep had stiff macro-hairs (112.83 cm^{-2}) and large, silicified prickle hairs (59.00 cm^{-2}). Simple prickle hairs with comparatively lower density (39.83 cm^{-2}) were present on Pachchaperumal stem. The higher density and the distribution of surface protrusions increase the spore adhesion, retention and germination on leaves, making Pachchaperumal more susceptible to blast disease, while higher densities of silicified prickle hairs on Tetep develop resistance by acting as barriers. The rough surface morphology of Tetep plays an important role in resistance to rice blast disease, whereas comparatively smoother surface morphology of Pachchaperumal increases the susceptibility of the plants to the disease. This overall study will be important in identifying defense mechanisms of rice blast resistant in relation to morphological features which will be helpful to develop morphological markers.

Effect of root application of soluble silicon on white rust disease in *Alternantherasessilis* ('Mukunuwenna') leaves

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Soluble silicon (Si) is reported to elicit resistance against fungal pathogens in many plants. Si can get accumulated beneath the cuticle to form cuticle-Si double layerinterfering the pathogen penetration and also could induce defense responses similar to systemic acquired resistance by producing antifungal compounds. Generally, plants can be categorized as high Si accumulators (> 1% tissue dry weight), intermediate accumulators (0.5-1%) and excluders (<0.5%). This study investigated the effectiveness of soluble in controlling white rust disease caused by *Albugo* sp. In the leafy vegetable *Alternantherasessilis* '(Mukunuwenna) and the mechanisms underlying Si-induced disease resistance. *A. sessilis,* cultivar 'Piliyandala' was grown in bags containing sand: top soil: compost 1: 2: 2 ratio as the medium. Si concentrations, 50 ppm and 100 ppm, as potassium silicate (K_2SiO_3) were applied to the growth medium. For positive controls, potassium (K) fertilizer was added to compensate the effect of K as K_2SiO_3 in 100 ppm and 50 ppm treatments. Media without added Si served as negative controls. Si was applied on the day of planting and until harvest at two week intervals. Each treatment contained 10 replicate bags arranged in randomized complete block design. Four weeks after planting, aerial parts were harvested. The trials were continued up to the 2nd and 3rd harvests. White rust severity (% leaf area diseased) was rated weekly. Harvested parts of 100 ppm, 50 ppm and negative control treatments were analysed for total Si content through colorimetry. Antifungal activity was assayed with *Cladosporium* bioassay for leaf extracts. Deposition of Si in leaf tissues was observed microscopically after staining with silver-amine chromate. Si treatment did not have a significant effect ($P > 0.05$) on the severity of white rust disease of *A. Sessilis,* cultivar 'Piliyandala'.However, Si-amended plants showed significantly higher ($p < 0.05$) total Si versus negative controls.   Neither Si deposition sites nor antifungal activity was observed in any of the treatments. *A. sessilis* can be categorized as a 'Si excluder' considering Si levels in leaves (0.261%-0.337%). Ineffectiveness of soluble Si to control white rust may be due to the plant's failure, it being a 'Si excluder, 'to elicit disease resistance.

Germination biology and chemical composition of a Sri Lankan medicinal herb: *Abutilon indicum*

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Use of medicinal plants dates far back to the initiation of civilization. However, synthetic drugs replaced the demand for medicinal plants and the former has been neglected for decades. Currently, due to many detrimental effects of synthetic drugs, the demand for medicinal plants has increased throughout the world. However, to meet the demand, these medicinal plants have to be cultivated. Thus, the purpose of this study was to develop a protocol to determine the proper seed propagation strategy for the medicinal plant *Abutilon indicum*.

Imbibition and germination of manually scarified and non-treated seeds were studied to determine the presence of physical dormancy (PY). Moisture content (MC) of seeds was determined with an oven dry method. Growth performances of seedlings were evaluated on three growth media under two shade conditions. Chemical composition of the plants from wild and cultivated populations was compared.

Results of the germination and imbibition tests revealed that *A. indicum* seeds have PY. MC of 8.5% suggested the orthodox seed storage behaviour. Growth performance indicators revealed that *A. indicum* seedlings grew significantly well in sand + coir dust + compost growth medium under 80% shade. Methanolic extract of the plant showed the presence of phytochemicals; saponins, phenolics, alkaloids, flavonoids, coumarins suggesting methanol extract as the best extraction media for this species. Methanolic extractions of cultivated population and wild population had a similar phytochemical composition. However, concentrations of phytochemicals were high in wild plants. Our study clearly demonstrated that the *A. indicum* can be cultivated economically without changing its medicinal value.

Effect of mistletoe infestation on fruit quality of nutmeg (*Myristica fragrans*)

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Perennial spices were observed to be highly infested by parasitic plants lately in Sri Lanka. Nutmeg is an important export agricultural crop (EAC) mostly grown in the wet and intermediate zones of Sri Lanka, providing income for rural communities. It is prone to parasitic plant infestation, but their effects on fruit quality have not been studied. Hence, this study was carried out to elucidate the effect of mistletoes (shoot parasites) on the fruit quality of nutmeg (*Myristica fragrans*).

The study was conducted during January to June 2016. Samples were collected from Ambulpure, Harispaththuwa (Kandy district)and Matale district (both in agro ecological region WM3b).Approximately 20 years old nutmeg plants of which about 20% of the canopy parasitized by the mistletoe *Dendrophthoeneeilgherrensis*in the two locations were selected. Uninfested trees were taken as the control. Five each of mature fruits were collected from three trees from each category, from the proximal and distal ends of the infested branches. Length and width of fruits, fresh and dry weights of fruit, seed, mace and pericarp, thickness of pericarp were measured. Data were analyzed using analysis of variance and mean separation was done by least significant difference, using SAS statistical package. Visual quality was evaluated using a quality chart.

The infestation of nutmeg by the mistletoe *Dendrophthoeneeilgherrensis* drastically decreased the quality of nutmeg. The length, width and weight of the whole fruit, pericarp, mace and nut of nutmeg in the distal end were significantly smaller than in the proximal end, all of which were significantly smaller than that of the uninfested control. The colour of the nut and mace was not affected by the infestation. However, when the dimensions and colour of the nut and mace that are important in determining the export quality were considered, the nut and mace of the infested plants belonged to grade two whereas the nut and mace of uninfested control belonged to grade one. Hence, importance of control of the mistletoe parasitism in nutmeg is emphasized.

Plant Sciences and Forestry

Potential to receive agricultural information through internet radio: a case of flower growers in Matale district in Sri Lanka

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Krushi FM is an internet radio initiated in 2013 by the Department of Agriculture to broadcast agricultural radio programmes via internet. Since the web-radio is still at its inception, it is necessary to explore effective mechanisms in using the web radio in agriculture information dissemination. The potential to use internet radio among flower growers in *Matale* district was studied.

Before and after study design was used. Preliminary data was collected from the study community using a questionnaire (n=115) to study the awareness of Krushi FM and the potential to access the internet radio. After the first survey, farmers were formally informed on the Krushi FM. Thirty farmers were purpose fully selected after the introduction, based on the availability of smart phones and computer-based internet access and telephone interviews conducted after one week.

According to the findings a few respondents (4.39%) were aware of Krushi FM before the formal introduction, while none of the respondent had listen to the internet radio at this stage. Nearly 37% of the respondents could access internet at home. Most (67%) had internet access via personal computers such as laptops and desktops while some (33%) had internet access through smart phones. About 42.98% of the respondents had moderate to high familiarity with internet usage.

After the awareness programme 37% of the sample had listened to the Krushi FM, and all of them had listened through an android application developed by the Department of Agriculture. Nearly 50% of these listeners had listened using smart phones that belonged to their family members.

The listeners were generally interested in Krushi FM to receive agricultural programmes. The main problems faced by the listeners were poor internet signals, lack of time to listen to it, poor internet literacy, and cost involvement when listening through internet. The study concluded that there is a potential to promote Kurshi FM among flower growers in *Matale* district, due to internet availability and familiarity. Android application can be considered as the best way to listen to the web radio.

In vitro rooting and acclimatization of *Aeglemarmelos* (L.) correa (bael)

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An effective protocol for *in-vitro* rooting and acclimatization of *in-vitro* cultured *Aeglemarmelos* (L.) correa (bael) shoots were investigated. The effect of two different growth media (full strength Murashige and Skoog's medium and sterilized sand medium), two auxins (Indole-3-Butric Acid 'IBA' and Napthalene Acetic Acid 'NAA') and three concentrations of each auxin (500, 1000, 2000 mg/L) on rooting and acclimatization was investigated using twelve replicates per each treatment. Two controls were maintained for both media separately. The experiment was conducted under aseptic condition. Ten weeks after establishment, plants were randomly selected and measurements such as rooting percentage, number of roots per shoot, average root length, plant dry weight, survival percentage and plant carbon content were taken. Another set of rooted shoots were acclimatized and survival percentage was taken four weeks after acclimatization.

With respect to the results obtained, the root initiation of shoots treated with auxin was faster than the non-treated shoots. The treatment of 2000 mg/L IBA with MS medium showed the highest rooting percentage (58.3%) while control for MS media gave the lowest (8.3%).Shoots treated with NAA produced more number of roots per shoot, however, IBA treated shoots produced longer roots. Survival percentages of IBA treated plants cultured in both media were higher (100%) at ten weeks after culture establishment and four weeks after acclimatization indicating the performance of IBA is better than NAA. Plant dry weight increased significantly (< 0.05) in MS media due to supply of all the nutrients that plants required. Irrespective of the auxin treatment, organic carbon content of plants in the sand medium was significantly higher ($p<0.05$) due to their higher photosynthesis. Greater photosynthetic capacity gives plants the ability to overcome the stress during acclimatization and to remain viable. Thus, it can be concluded that, the MS medium with 2000 mg/L IBA (T4) is the most effective treatment for *in-vitro* rooting of bael. Second most effective as well as the most cost effective treatment is the sand medium with 2000 mg/L IBA (T11).

Efficacy of *Tithonia diversifolia* leaf extracts to inhibit selected fungal pathogens of ornamental foliage plants

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Ornamental foliage are used globally for various purposes and has an accelerating demand. However, they are highly susceptible to various pathogenic fungi, which reduce the quality. Growers use synthetic fungicides to overcome these problems, which have led to negative impacts on environment and human health. Consequently, demand for the natural fungicides is increasing and attempts have been taken to produce natural fungicides using various plant species. Though, invasive plants are considered to cause environmental damage, there is a potential to use these plants as natural fungicides due to the presence of bioactive compounds within them. *Tithonia diversifolia*, is an invasive alien plant species in Sri Lanka. The aim of this study was to find the efficacy of *Tithonia diversifolia* leaf extracts to inhibit selected fungal pathogens of ornamental foliage plants by identifying its bioactive compounds. Extractions were done using three types of solvents viz. methanol, dichloromethane and n-hexane and antifungal activity was tested against *Curvularia* sp. *Fusarium* sp. and *Alternaria* sp.; fungi causing leaf spot diseases in ornamental plants. Highest inhibition for *Curvularia* sp. and *Fusarium* sp. were obtained in n-hexane and methanolic leaf extracts respectively. Minimum inhibitory concentration for the *Curvularia* sp. in n-hexane was 0.0175 g/ml and minimum inhibitory concentration for *Fusarium* sp. in methanolic extract was less than 0.0175 g/ml. Leaf anatomical observations revealed three types of trichomes in leaves of *Tithonia diversifolia*. They were non grandular trichomes and two types of glandular trichomes known as capitate and non capitate type. Phytochemical constitution in these three extracts were done through preliminary tests and it reveals that chemical constitution of the three extracts are different from each other where methanolic and dichloromethane were capable in extracting more secondary metabolic compounds. Methanolic and dichloromethane were assayed for total phenolics and methanolic extract had the highest total phenolics content with a 4.4963 µg/ml. Therefore, it can be concluded that leaf extracts from *Tithonia diversifolia* have the potential to be used as a natural fungicide on disease causing fungi in ornamental foliage plants.

An *in-silico* analysis of the genetic diversity of *ABRE-BP* among Sri Lankan rice varieties: could a polymorphism in *ABRE-BP* be diagnostic of salinity tolerance?

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The *ABRE-BP* (*Abscisic Acid Responsive Element binding protein*) is a key gene in the abscisic acid (ABA)-dependent plant salinity stress-responsive regulon. The gene transcribes for a transcriptional factor and binds with the ABRE*cis*-acting element in salinity stress responsive genes, regulating its expression. A greater diversity in salinity tolerance has been reported in Sri Lankan rice germplasm while *Pokkali*c has been consistently identified as a tolerant variety. In the current *in-silico* study, we assessed the nucleotide diversity of the *ABRE-BP* genic region of 47Sri Lankan rice varieties to identify putative diagnostic sites associated with salinity responses. The *ABRE-BP* sequences were retrieved from the Rice SNP-Seek data base and the exon/intron regions and protein domains were annotated. DNA polymorphisms leading to non-synonymous mutations were identified compared to *Pokkali*. A cluster analysis was carried out considering the non-synonymous mutations and the nucleotide diversity index (Pi) were calculated. The entire *ABRE-BP*genic region consists, 208 single nucleotide polymorphisms (SNPs) including 13 singletons and 195 parsimony variables. The *ABRE-BP* coding sequence (CDS; Pi:0.00617) was generally conserved comparing to the genic region (Pi:0.00817). The intron region of *ABRE* consisted of 179 SNPs. In the CDS, the exon one has the highest polymorphism with 23SNPs followed by exon five (3), exon two (2), and exon three (1). The exon four was conserved across all varieties. The *ABRE-BP* polypeptide chain consisted of 12 non-synonymous mutations where, 11 in exon one and one in exon three, that clustered the selected varieties in to four groups. The exon three contains the bZIP domain which produces the ABRE transcription factor. The bZIP domain was annotated to be longer in six varieties compared to the rest, enclosing the non-synonymous mutation at exon 3 (lysine to asparagine). The cluster of 26 varieties contained, tolerant varieties *Pokkali, Kuruluthudu* and *Kotteyaran* with known intolerant varieties *Pachchaperumal* and *Hondarawalu*. The *ABRE-BP* sequence of *Pokkali* differed from the rest, by a single non-synonymous mutation (Tyrosin to Aspartate) on exon 1, however, could not be associated with salinity tolerance. Thus, the tolerance of *Pokkali* and other tolerant varieties could not be diagnostically associated to the polymorphisms detected in the *ABRE-BP* genic region.

Does restoration promote recruitment of woody species in pine plantations in Lower Hantana, Sri Lanka?

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Thinning and enrichment planting to convert poorly managed monoculture exotic plantations to mixed species plantations plays a crucial role in the maintenance of biodiversity and ecosystem services. Therefore, this study was conducted to investigate the woody seedling recruitment in a restored *Pinus caribaea* Morelet stand (RP) and an unrestored pine stand (UP) in lower Hantana, Sri Lanka. The density, richness and diversity of seedlings of woody species were determined in RP and UP stands.

Fifteen plots ($5*5$ m^2) were established randomly per site and three subplots ($1*1$ m^2) were laid inside each plot. Seedlings (<50 cm of height) of woody species that emerged in subplots ($1*1$ m^2) were tagged and identified. A total of 840 seedlings of woody species belonging to 14 plant families and 32 species were recorded from both sites (570 seedlings belonging to 14 families and 24 species from the RP; 240 seedlings belonging to 12 families and 16 species from the UP). The mean density of seedlings was higher in the RP (3.6 seedlings m^{-2}) than the UP (3.0 seedlings m^{-2}) and species richness was higher in the RP (24) than the UP (16) stands. Moreover, species diversity was higher in the RP than the UP. Seedlings of pioneer species dominated both sites, with nearly equal percentages. A higher percentage of native species was recorded in both sites (RP=.66%, UP =55%) than endemic and exotic species. *Artocarpus nobilis* Thw. the only endemic species recorded during the study emerged from the RP.

Our study concludes that the plant diversity in the RP is greater than the UP, probably resulting from the alteration of microclimatic conditions due to restoration effort.

Line X tester analysis for root characteristics in selected hybrid rice combinations

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Twenty five F1 hybrid rice combinations were produced using five Cytoplasmic Male Sterile (CMS) Testers (IR68902A, IR70369A, IR68902A and IR78354A) and, five Restorers (Lines) R147(IR72998-93-3-3-2R), R156(IR73885-1-4-3-2-1-10R), R317(IR183325-66-2-1-NPT), 160(IR75282-58-1-2-3), SN10-2071 following the line x tester mating design. The 25 cross combinations and the ten parents were tested for root traits which have a strong bearing on the final yield in Maha 2014/2015 and Yala 2015 seasons at the Rice Research and Development Institute, Batalagoda, Ibbagamuwa, Sri Lanka. The objective was to study the influence of hybrid combinations on root volume and root dry weight, through Line x Tester analysis.

Analysis of variance for root volume/plant (RV/P) indicated that all the genotypes: parents, lines and crosses were significantly different at 1% probability level. Parents, crosses and lines were significantly different among themselves at 1% probability level for root dry weight per plant (RDW/P) as well. However, testers showed significant differences only at 5% probability level for root dry weight. Three way interaction (Line x Tester x Season) was also found to be significant for root volume and root dry weight at 1% and 5% probability level, respectively.

According to the response curve analysis, in both Yala and Maha seasons, the Tester 30 (IR 78359A) had the highest average performance. Tester 29 (IR 78359)/ Line 3 (IR183325-66-2-1(NPT)) was the best specific hybrid combination for the root volume in both seasons. In the Maha season, performances of different testers with different lines appeared highly unpredictable with respect to root dry weight per plant. However, cross combination [IR68902A/IR75282-58-1-2-3(R160)] was the specific combination which produced high root dry weight per plant. The combination Bg CMS 4A/ line 3 [IR 183325-66-2-19NPT)] was identified as the best combination in Yala season with respect to root dry weight per plant.