

AWARENESS AND DISTRIBUTION OF INVASIVE ALIEN SPECIES (IAS) OF FLORA IN GALIGAMUWA AREA

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Biological invasions happen either deliberately or accidentally and are considered as serious threats to the biodiversity and its irreversible impact to the biodiversity is second only to the habitat loss. Thirty common IAS of plants were selected and the study inquired whether the local people were well aware about IAS of flora and if so, whether these species have badly influenced the environment and farming activities and its distribution in Galigamuwa area. Primary data were collected through a pretested self-administered questionnaire and 65 households were selected by using Multi stage random sampling technique. Analysis was carried out based on descriptive statistics together with graphical interpretation.

According to the depicted results, all the respondents (100%) were aware about IAS of flora. Majority of the respondents (46%) educated through newspapers. Only few respondents (6%) were aware about Guinea grass (*Panicum maximum*), one of the prominent IAS of flora in Sri Lanka. Moreover, very few respondents were aware about Rila Thana (*Pennisetum polystachion*) 2% , Wal Sudda (*Austroepatorium inulifolium*) 12%, Mist flower (*Ageratina riparia*) 3%, Gal Goraka (*Clusia rosea*) 7%, welvet tree (*Miconia calvescens*) 6%, Kikiyu grass (*Pennisetum clandestinum*) 2%, Parthenium (*Parthenium hysterophorus*) 12%, Kattakumanjal (*Myroxylon balsamum*) 8%, Yellow cestrum (*Cestrum aurantiacum*) 3%, Blue stars (*Aristea ecklonii*) 2% and Arunadevi (*Sphagneticola trilobata*) 2%. According to the depicted results, respondents have not observed Kikiyu grass (*Pennisetum clandestinum*) and Rila Thana (*Pennisetum polystachion*) in their surroundings. Moreover, no respondents (0%) were aware about Gorse (*Ulex europaeis*). Results revealed that, majority of the respondents have seen water hyacinth (*Eichhornia crassipes*) 69%, salvinia (*Salvinia molesta*) 54%, Katu pathok (*Opuntia dilenii*) 57%, Katakalu Bovitiya (*Melastoma hirtum*) 60%, Wathupalu (*Mikania micrantha*) 72%, Mahogani (*Swietenia macrophylla*) 74%, Lantana (*Lantana camara*) 55%, Podisingnomaran 62% in their surrounding environments. While 69% of the respondents were aware about pinus (*Pinus caribaena*), only 25% of them have seen pinus in their surroundings. Of the sample, majority of the respondents were aware about Ginikuuru Gas (*Alstonia macrophylla*) 51%, Wild sunflower (*Tithonia diversifolia*) 58%, Para (*Dillenia suffruticosa*) 58% and Yoda nidikumba (*Mimosa pigra*). Very few of the respondents were aware about Katu Andara (*Prospis juliflora*) 35%, cuscuta (*Cuscuta compestris*) 40%, Kadadasi Mal (*Antigonon leptopus*) and Cheena Pera (*Psidium littorale*) 25%.

Of the sample, majority of the respondents (58%) were facing difficulties in their day to day lives due to IAS of flora and most of them (52%) try to control these plants. Majority of the respondents (43%) have observed the reduction of native plant species due to IAS of flora and 37% of the respondents do not have clear idea about the adverse impacts of IAS of flora. According to the results, 45% of the respondents have reported that IAS flora have badly affected to their aquatic environments.

SELENIUM IN RICE (*ORYZA SATIVA*) FROM DIFFERENT GEOGRAPHIC AND CLIMATIC REGIONS OF SRI LANKA

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Rice is the main staple food in Sri Lanka as in many other Asian countries. It has been identified that people who consume rice as a staple food are inevitably exposed to significant amounts of different trace elements. Among these trace elements, selenium (Se) is one of the least known, but essential element for both humans and animals. Deficiency of Se can increase the susceptibility of the kidney's to oxidative damage, but Se becomes toxic to humans when the intake exceeds 900 µg/kg per day.

Availability of Se and other bio-important trace elements in rice from Wet Zone (WZ), Dry Zone (DZ) and Intermediate Zone (IZ) were investigated in this study. Concentrations of 19 trace elements in 200 rice samples, including improved (n=188) and traditional rice varieties (n=12) were measured with Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after microwave aided acid digestion.

The Se contents in improved rice varieties ranged from 0.03 to 261 µg/kg with mean values of 35.4 µg/kg, 42.8 µg/kg and 22.1 µg/kg for WZ, DZ and IZ, respectively. Comparatively higher Se levels were recorded in white polished rice varieties from the DZ and IZ than brown rice varieties from the same regions. Comparatively higher Se levels were observed in traditional rice varieties that varied from 77.51 to 163.8 µg/kg with the mean of 116.4 µg/kg. Among them, the highest Se content was reported in "Maa Vee", which is widely recommended for diabetes, tuberculosis, constipation, hemorrhoids and cardiovascular diseases in traditional medicine. Based on the average daily consumption of rice by a person, the total daily intake (TDI) of Se was calculated. The TDI are 10.04 µg, 12.14 µg and 6.26 µg from rice of WZ, DZ and IZ, respectively. Results of the study also demonstrate that the Se concentration does not vary significantly among climatic zones. Though Se is available in other foods such as garlic and other vegetables, the recorded values for Se in rice are far below the recommended daily Se intake. Although some early studies indicated higher arsenic (As) contents in Sri Lankan rice, this study reveals that it is well below the Codex Alimentarius recommended maximum allowable limit.

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SPATIAL VARIABILITY OF ORGANIC CARBON DENSITY IN CASHEW CULTIVATED RED LATOSOL SOILS OF SRI LANKA

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Soils contribute to regulate major biochemical cycles and in case of carbon (C) cycle it plays a vital role. In fact soil act as the largest terrestrial pool of C. Therefore, much attention is given to quantification of below ground C stocks or densities and uses this information for long term monitoring of C sequestration potential. In this study, an attempt was made to quantify the spatial variability and subsequently map (predict) the soil organic carbon (SOC) densities under cashew grown in Red Latosol soils. For this, a sub set of 22 ha was selected from the cashew seed garden in Elluwankulama, Puttalam district managed by Sri Lanka Cashew Corporation. A design-based sampling scheme namely stratified random sampling was adopted in this study. The stratification was carried out using compact geographic stratification (based on coordinates) with the aid of k-means clustering algorithm and the study area was divided into five strata. Total of 100 sampling locations were sampled where 20 sampling locations were allocated to each stratum. For all sampled locations, SOC density (kgm^{-2}) was calculated. In calculating of SOC density, a pedotransfer function (PTF) was used to predict the bulk density for sampling locations which did not measure bulk density in the field. Geostatistical approach was used to create higher resolution digital soil map of SOC density across the study site. Both PTF predicted bulk density values and geostatistical models were validated and statistically assessed using mean error (ME) and root mean square error (RMSE) indices.

Summary statistics revealed that mean SOC %, bulk density and SOC density reported as 0.96 % (± 0.21), 1.43 gcm^{-3} (± 0.03) and 4.12 kgm^{-2} (± 0.82), respectively. Results revealed that the bulk density values predicted by PTF reported ME of 0.0041 gcm^{-3} and RMSE of 0.0044 gcm^{-3} values for Red Latosols in the study site. The optimum spatial model for SOC density was identified as spherical model which reported lowest RMSE (0.769 kgm^{-2}) and ME (0.00084 kgm^{-2}) values. The nugget-to-sill ratio showed a moderate spatial dependence for SOC density (0.43). Furthermore, results revealed that spatial auto-correlation (range parameter) of SOC density goes up to 82 m. This indicates that in future sampling of Red Latosols in order to characterize the spatial variability of SOC density, sampling interval should be maintained within 82 m. Predicted SOC density over the study area reported a mean value of 4.14 kgm^{-2} (± 0.34) while 3.95 kgm^{-2} and 4.34 kgm^{-2} for quantiles one and third, respectively. Results further revealed that majority of the land extent (13.4 ha) in the study site reported SOC density in between 4.0 to 4.5 kgm^{-2} . The information generated in this study could be useful in national carbon accounting programs, carbon credit programs and for site specific fertilizer application.

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**DEVELOPMENT OF LAND SUITABILITY MAP TO EXPAND RUBBER
IN NORTHERN DRY ZONE OF SRI LANKA:
A CASE STUDY FROM VAVUNIYA DISTRICT**

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The land extent of traditional rubber growing areas in the Wet Zone of Sri Lanka is limited due to various development activities. Therefore, expansion of rubber into non-traditional areas is vital to increase the extent under rubber cultivation and to meet the production target of the country. This study was aimed at developing a land suitability model and using it for mapping of potential areas where rubber can be cultivated in the Dry Zone of Sri Lanka considering a case study from Vavuniya District.

Weighted overlay analysis in Geographic Information System (GIS) environment was carried out to develop a land suitability model where weights for the main variables namely; annual cumulative rainfall, maximum and minimum temperatures, elevation, slope of the land and soil type were determined using Analytical Hierarchical Process (AHP). Once the land suitability map was derived, potential land areas where rubber can be cultivated in the district were identified.

Results of the AHP revealed that rainfall, minimum temperature, maximum temperature, slope, elevation and soil type were allocated weights of 39%, 7%, 15%, 6%, 5% and 28%, respectively in the land suitability model. Furthermore, results revealed that out of total potential land for expansion of rubber cultivation in the Vavuniya District, 19,751 ha of land were “Moderately suitable” while 3,297 ha of lands were categorized under “Unsuitable” and “Most unsuitable”. As the Vavuniya District has no optimum soil condition for rubber cultivation, proper ways of amending soils should be carried out. The outputs generated from this study provide firsthand information for policy makers related to expansion of rubber in the Northern Dry Zone of Sri Lanka.

GEOSTATISTICAL MAPPING OF SELECTED SOIL CHEMICAL PROPERTIES IN RED LATOSOLS OF SRI LANKA

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Soils are highly variable even at the field scale and detailed studies of spatial variability of soil properties across the landscape are important to manage soils in a sustainable manner. Geostatistics enables to quantify the spatial variability and subsequently prepare detailed digital soil maps. In this study, an attempt was made to quantify the spatial dependence and map the selected soil chemical properties (*viz.* pH, exchangeable potassium (K) and available phosphorus (P)) in Red Latosols of Sri Lanka.

As the study site, a sub set of 22 ha was selected from the cashew seed garden in Elluwankulama, Puttalam District managed by Sri Lanka Cashew Corporation. A design-based sampling scheme namely stratified random sampling was adopted in order to collect soil samples. The stratification was carried out using compact geographic stratification using k-means clustering algorithm and study site was divided in to five strata. Total of 100 sampling locations were sampled where 20 sampling locations were allocated to each stratum. For each considered soil chemical property we deployed a geostatistical approach to create higher resolution digital soils maps and to quantify the spatial distribution of respective soil chemical properties across the study site. The geostatistical models were cross validated and calculated mean error (ME) and root mean square error (RMSE) in order to assess the model quality.

Spatial model quality results obtained from the cross validation analysis revealed that, calculated ME values for soil pH (0.002) exchangeable K (0.403 ppm), and available P (0.004 ppm) were closer to zero which suggests unbiased estimation. In case of RMSE, all considered soil chemical properties reported lower values, which includes for soil pH (0.354), exchangeable K (13.581 ppm), and available P (1.673 ppm), respectively suggesting accurate estimation. In analysis of spatial dependence, nugget-to-sill ratio showed strongly structured spatial dependencies with negligible random variations for all considered soil chemical properties. Results further revealed that spatial correlation (range parameter) of pH, exchangeable K and available P reported as 31 m, 98 m and 54 m, respectively. This information is vital to carry out future soil sampling of Red Latosols in order to optimally characterize the spatial variability of considered soil chemical properties by maintaining sampling interval within the estimated range parameter. Furthermore, it was indicated that pH values in most areas of the study site varied from very strongly acidic (4.5) to strongly acidic (5). The exchangeable K and available P levels are mainly distributed within fairly low (58.5-78 ppm) to medium (78-97.5 ppm) and fairly low (7.5-15 ppm) categories, respectively.

Maps produced in this study provide valuable information on spatial distribution of considered soil chemical properties including nutrient status within the study site that can be used as a guide to conduct site specific fertilizer applications, intercropping and other management practices, in an environmental friendly manner.

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ASSESSMENT OF NITROGEN, PHOSPHOROUS AND POTASSIUM CONCENTRATIONS IN DIFFERENT RAW MATERIAL VERMIWASH

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The study was carried out from November 2014 to April 2015 within the premises of Vavuniya Campus of University of Jaffna. The main objective of this study was to analyze nitrogen, phosphorus and potassium (NPK) concentrations of vermiwash (VW) prepared with different raw materials. Study was targeted on several other objectives such as to seek the handiness of recycling vegetable waste and mango leaves through VW preparation, to prepare VW from green plant species which cause trouble in the environment.

Five plastic barrels were used to establish the vermi-bed. A tap was fixed at one horizontal limb of the container. Then, a base layer of small gravels was placed. Over that a layer of fine sand was placed. Then, a layer of top soil was added and it was covered with a layer of cow dung. Excess amount of water was sprayed and allowed to drain-off. After that the tap was closed. Four different types of raw materials, namely vegetable waste, mango (*Mangifera indica*) leaf litter, parthenium (*Parthenium hysteroporus*) and water hyacinth (*Eichhornia crassipes*) were used for the preparation of VW. Control unit was maintained. In control, only top soil and cow dung bed were used without adding any extra feeding material. Locally available Earth worms (EWs) were collected from an open land field of Agriculture School in Vavuniya, where livestock wastewater discharges. Fifty surface and subsurface local EWs were introduced in to each vermi-bed. After 60 days of processing, 4.5 L of VW from each unit was collected after passing 5 L of water into each unit. Three samples from each Vermiwash preparation unit and control were collected for physiochemical analysis. Physiochemical characteristics of different raw material driven VW were analyzed using one-way ANOVA. Significant differences were observed between different raw material driven VW and control, including available NO_3^- - nitrogen ($P \leq 0.0001$), available PO_4^{3-} - phosphorous ($P \leq 0.0001$), exchangeable potassium ($P \leq 0.0001$). Highest concentrations of nutrients were recorded in Parthenium VW (highest NO_3^- - N) and Vegetable waste VW (highest PO_4^{3-} and highest K^+). The pH of VW was slightly alkaline (7.6 – 8.4). Vermiwash with 1:5 dilution (V/V) was lying within a range of 7.1 - 7.4. Near neutral range of 5.5 - 8.5 is suitable for crop foliar spraying solutions. EC range of 0.5 – 1.5 dS/m in soil indicates suitable condition for cropping. Electrical Conductivity (EC) of different types of VW with 1:5 (V/V) dilutions was confirmed range from 0.7 – 1.4 dS/m.

This study confirmed feasibility of VW preparation with environmentally troublesome weeds (Parthenium and Water hyacinth). The vermiwash contains considerable concentrations of nutrients in it. Vermicomposting is increasingly becoming popular as an organic solid waste management strategy. The preparation of VW with selected raw material confirmed alternative solution for controlling vegetable waste and mango leaf litters because there is no garbage after prepared VW. The amounts of nutrients in VW will be sufficient to apply for leafy vegetables where low chemical fertilizer applications are prescribed. There is still a requisite of continuing study in this field ahead to, compare the effectiveness of VW application on crop growth with recommended chemical fertilizer application. That will find whether VW replace the chemical fertilizers fully or partially; and to confirm relationship between nutrients concentration in pure raw materials and after it is proceeded in to Vermiwash.

SPATIAL VARIABILITY OF SELECTED SOIL CHEMICAL PROPERTIES FOR AGRICULTURAL LAND MANAGEMENT

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Soil spatial variation data of chemical parameters are needed for better agricultural management, sustainable land use management and soil conservation. There is a need to produce accurate soil maps of chemical parameters cost effectively. This study was undertaken to quantify spatial variability of soil properties by a kriging method. Seventy sampling points were selected for this research using stratified random sampling method. Stratification was based on the type of land cover patterns, which were designated as forest patches, agriculture land patches, grass land patches and catchments. Sampling points were randomly selected from each land cover type. Minimum distance between two adjacent sampling points was 500 m. Soil samples were analyzed for pH, EC, exchangeable K and available P. In each location, soils were collected from top to - 30 cm depth (root zone) using a core sampler and sub soil samples were collected around the geo-referenced point to obtain a composite sample. Geostatistical software was used to construct semi-variograms and spatial structure analysis for the variables. Geostatistical estimation had done by kriging. Acidic soil was identified in agriculture land around 13% of area, 6% alkaline soil, and 13% of agriculture land area was identified as saline soil. Accordingly, 32% of agriculture land area was identified as problem soils. Fourteen percentage of agriculture lands contain more available P concentration than the optimum range of 15- 22 ppm and 4% agriculture lands contain higher exchangeable K concentration than the optimum range of 78-97.5 ppm suitable for crop cultivation. Ninety eight percentage of forest lands and 100% of grass lands contain available P concentration higher than the optimum range. But forest lands and catchments showed lower level of exchangeable K concentration. Twenty percentages of grass lands contain higher exchangeable K than the optimum level. Agriculture practices leads to changes in the soil. Hence, identified soil problems should be reclaimed to maintain the fertility of soil for sustainable production. Proper management of soil can be a better solution for supporting the successful agricultural activity of a community in future and socio-economic development in a sustainable way.

INTERACTION OF FERROUS IONS AND FREE CHLORINE ON MICROBIOLOGICAL QUALITY OF DRINKING WATER

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University of Peradeniya has a nearly 60 year's old water distribution network that consists mainly iron pipelines, most of which are now corroded to a large extent, adding iron rust to water. The aim of this study was therefore to investigate the possible consumption of free chlorine that added in to water for disinfection by iron dissolved from pipes. If free chlorine is reduced due to iron, the available amount of free chlorine would not be sufficient for the disinfection of microorganisms in water.

A laboratory simulated study was carried out to investigate the possible reaction between ferrous ion (Fe^{2+}) and free chlorine in water using a series of Fe^{2+} and free chlorine mixtures. The effect of the reaction on the inhibition of microorganisms were also determined by spiking *Serratia spp.* (a total coliform) and *Escherichia coli* (a fecal coliform) into known mixtures of Fe^{2+} and free chlorine. The Fe^{2+} and free chlorine contents were measured spectrophotometrically while viable microbial count was assessed using membrane filtration technique that followed a confirmation tests. Furthermore Fe^{2+} , free chlorine and microbiological quality were determined periodically using 27 water samples that were collected from various points of the University network.

The results of this study indicated a rapid reaction between Fe^{2+} and free chlorine. The rate of free chlorine reduction was directly proportional to the amount of Fe^{2+} in water. Although inhibition of *Serratia spp.* and *E. coli* was observed due to free chlorine in water, the effect reduced drastically with increasing Fe^{2+} in water. *Serratia sp.* decreased gradually with the ascending chlorine levels at Fe^{2+} levels of 0.2 and 1.0 mg/L. Total inhibition of *Serratia sp.* were observed at 2 and 3 mg/L of Fe^{2+} while *E. coli* was inhibited at Fe^{2+} levels of 1.0, 2.0 and 3.0 mg/L. The Fe^{2+} content in the water distribution network of University of Peradeniya were ranged from <0.01 mg/L to 0.64 mg/L (desired value is <0.3 mg/L), while the desired free chlorine level (0.2 mg/L) was observed only at two locations (Faculty of Veterinary Science and Meewathura treatment plant). Total coliforms were detected in samples collected from Upper Hanthana, Marcus Fernando Hall, University Temple, Science Faculty, Mars Hall and Medical Faculty, while fecal coliforms were detected only in a sample from Marcus Fernando Hall. The results of microbiological test showed that water distributed from the Kandy Municipal Council and Meewathura plants are suitable for drinking, but water distributed from the Upper Hanthana plant was not suitable for human consumption according to the World Health Organization (WHO) Standards (0/CFU per 100 ml for both total and fecal coliforms) and Sri Lankan Standards (3/CFU per 100 ml for total coliforms and 0/CFU per 100 ml for fecal coliforms). The possible reason behind the unsuitable microbiological quality of water may be related to the reaction between Fe^{2+} and free chlorine in water. It was also noted that, a high level of Fe^{2+} in water was inhibitory to microorganisms in water and remove bacteria by formation of clumps.

FLUORIDE UPTAKE BY NATIVE AND MODIFIED CATTLE BONES FROM AQUEOUS MEDIUM BY BATCH ADSORPTION

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Fluoride (F⁻) is found in excess compared to the WHO recommended levels in drinking water in the Kandy district. Health hazards such as dental fluorosis, skeletal fluorosis, crippling fluorosis and metabolic defects in lipids, proteins and vitamins are caused due to excess F⁻ in drinking water. Among several defluoridation techniques, adsorption is the most effective and common method. The objective of this study was to investigate the effectiveness of the natural, economically feasible and eco-friendly materials such as plant leaves and cattle bones for removing fluoride ion from drinking water using batch adsorption method. Bio-adsorbent materials were collected and rinsed initially with tap water, and then with deionized water. Cleaned materials were air dried for 48 h and oven dried at 60°C for 48 h. Dried materials were sieved to obtain particle size between 250 – 350 µm. Batch adsorption experiments were conducted. A mass of 0.2 g of different adsorbents was added in 50 mL of 3 mg L⁻¹ fluoride solution and shaken at 80 rpm in orbital shaker for 3 h. Thereafter, suspension was filtered and final F⁻ concentration was determined by fluoride ion-selective electrode. Chemical and physical modifications such as base treatment and bone char preparation were done to enhance the adsorption efficacy. Native bones were heated at 500°C for 3 h in muffle furnace to prepare bone char (BC). Effect of contact time and dosage were determined for chemical modification and effect of pH, kinetic studies, isotherm studies, desorption and adsorbent characterization for BC were carried out. F⁻ adsorption on BC was maximum between pH 4-7 and equilibrium time for BC was 12 h. Pseudo second order kinetic model and Langmuir isotherm model described adsorption of F⁻ on BC. The highest desorption was given with 0.1 M NaOH. BC enhances the efficacy of defluoridation from aqueous medium and is a cost effective and eco-friendly biosorbent.

Not Presented

IMPACTS OF SEA LEVEL RISE AND BED LEVEL ACCRETION ON RESIDENCE TIME OF NEGOMBO LAGOON, SRI LANKA

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Water quality of an aquatic system is highly influenced by residence time (RT), which indicates how long a constituent is retained inside the system. This paper focuses on the effect of climate change induced future sea level rise (SLR) and associated bed level variations on RT of Negombo lagoon, Sri Lanka. The hydrodynamic behaviour of the lagoon was numerically simulated using Delft3D surface water modelling suite. The time required to drop the concentration of a constituent to $1/e$ (≈ 0.37) of its original value was calculated as the RT of the lagoon. Anticipated maximum SLR of 79 cm at the end of the 21st century, predicted by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, was considered as the future sea level of the lagoon. Three bed level accretion conditions, namely, no bed level accretion, accretion of the lagoon bed level by 50% of the SLR (partial bed level accretion condition) and accretion of the lagoon bed level similar to the SLR (full bed level accretion condition), in response to the anticipated SLR were considered. RT was calculated for each bed level variation under low ($5.64 \text{ m}^3 \text{ s}^{-1}$) and high ($41.93 \text{ m}^3 \text{ s}^{-1}$) streamflow conditions.

Model predicted RTs of the lagoon at present are 22.4 days and 12.4 days under low and high streamflow conditions, respectively. Under the absence of bed level accretion, RT is increased up to 32.2 days (+43.7%) and 17.8 days (+43.5%) due to SLR in low and high streamflow periods, respectively. Under partial bed level accretion, RT is decreased up to 18.1 days (-19.2%) and 12 days (-3.2%) in low and high streamflow periods, respectively. RT is decreased up to 13.4 days (-40.2%) and 8.5 days (-31.5%), under full bed level accretion, in low and high streamflow periods, respectively. The results reveal that the climate change induced future SLR and the associated bed level accretion influence the RT of the lagoon altering the lagoon water quality.

**VERY LOW FREQUENCY ELECTROMAGNETIC (VLF EM) METHOD
FOR VEIN GRAPHITE INVESTIGATION IN
CRYSTALLINE ROCK TERRAIN:
A CASE STUDY IN RANGALA, SRI LANKA**

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Vein graphite formations in Sri Lanka show systematic orientation rather than random. They follow define brittle structures alone in mineralized regions, but pinching out behaviour of veins make them difficult to be detected by traditional drilling methods. At present, exploration for new graphite veins is important factor for continuation of graphite industry.

Electromagnetic Surveys are some of the most common survey methods in globe for the conductive mineral exploration. A Very Low Frequency (VLF) electromagnetic survey was carried out using EM 16 handheld instrument for the field data collection. Rangala graphite mine area is situated in the Kegalle district within the crystalline terrain of Sri Lanka. Survey grid was designed perpendicular to the primary signal transmitting direction.

Positive to negative inphase reading variation along survey lines was used as primary indication of subsurface conductor. Simple numerical filtering method was used to reduce random fluctuation of the anomalies. Interpretation of individual anomalies indicated that the conductive zones present at an average depth of 10m-15m.

These anomalies have followed vein orientation of NW-SE as shown by previous investigators. Overlapping of anomalies with already identified veins and drill hole data verified relationship between anomalies and graphite veins. At least fourteen conductive bodies were identified during the study, indicative of graphite veins. According to the anomalies, lengths of the veins vary between 20m-150m with steep dipping.

VLF anomalies indicated a very significant correlation with the already located graphite veins, thus conforming the other anomalies represent yet undiscovered graphite veins. The study further revealed that VLF method can be effectively and economically used in graphite exploration in Sri Lanka, instead of costly drilling based investigations.

P-T-t EVOLUTION OF CALC-SILICATE ROCKS IN THE SOUTH-WESTERN HIGHLAND COMPLEX OF SRI LANKA

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Recent studies on calc-silicate rocks from the Southwestern Highland Complex of Sri Lanka have renewed the interest on the reconstruction of the P-T-t and fluid evolution in this part of the island. Present study is another contribution to understand the P-T-t path and fluid conditions of the calc-silicate lithologies around Galle and Middeniya-Embilipitiya areas in the Southwest.

Based on petrography and mineral assemblages, the studied calc-silicate lithologies can be subdivided into three main groups; Group I – wollastonite-bearing but grossularite-absent assemblages, Group II – grossularite-bearing but wollastonite-absent assemblages, Group III - both wollastonite and grossularite-absent assemblages. Formation of different assemblages is possibly a result of peak metamorphic P, T conditions, the chemistry of protoliths, graphite precipitation and response to fluctuation of X_{CO_2} level during prograde path. Critical reaction textures in Group I lithologies indicate breakdown of, (1) wollastonite $CO_2 \rightarrow calcite + quartz$, (2) wollastonite + dolomite $\rightarrow calcite + diopside$, (3) scapolite $\rightarrow calcite + quartz + plagioclase$, (4) alkali feldspar + wollastonite $\rightarrow scapolite + quartz + K^+$, that are important in re-constructing the P-T-t evolution of the terrain. Diopside rims around quartz in Group II assemblage suggest the reaction, (5) dolomite + quartz $\rightarrow diopside + CO_2$. In addition, local occurrences of fluids involving reaction textures such as myrmekitic intergrowth of plagioclase + quartz between calcite + K-feldspar and replacement of diopside by hornblende have been observed in calc-silicate rocks from the study area. Peak metamorphic assemblage of the Group I suggests a stabilization temperature of about 800-850^oC at 5 kbar, and $X_{CO_2} \geq 0.2$ in the fluid phase. The retrograde reactions (1), (2) and (3) suggest isobaric cooling (IBC) following peak metamorphism during which internal fluid buffering prevailed. But the IBC reaction anorthite + wollastonite $\rightarrow grossularite + quartz$, noted from elsewhere was not present in the studied samples perhaps due to lower lithostatic pressure in the study area. The reactions (4) and (5) suggest isothermal decompression (ITD) following the IBC path, and other fluid involving reactions noted in the study area suggest both hydration and CO_2 influx during final stages of metamorphic evolution.

The retrograde reaction textures in the studied calc-silicates and the inferred IBC and ITD P-T-t segments for the Southwestern Highland Complex correlate well with the results of previous P-T-t studies of calc-silicate, pelitic and mafic rocks in the Highland Complex. Further, presence of grossularite-absent assemblages, the reaction textures (1), (3) and (4), and the inferred P-T-t path for the study area strongly correlate well with mineral assemblages, reaction textures and P-T-t evolution in the Kerala Khondalite Belt within the Trivandrum Block of Southern India.

SPATIAL VARIABILITY OF SOIL PROPERTIES IN A CALCIC RED LATOSOL SOIL SCAPE IN THE NOTHERN AREA OF SRI LANKA

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The information on the spatial variability of soil properties is vital for the better management of soil and to increase the crop productivity. This study was conducted to explore the short-scale spatial variability of selected chemical and physical soil properties of a Calcic Red Latosol soil scape in the Alaveddi area in the Jaffna district.

The study area consisted of 2.5 ha and samples were collected within the plough depth (0-30 cm) by using stratified random sampling scheme. This was achieved by firstly defining a sampling (spacing 29 x 29 m) grid. Subsequently, a random sample was added within each grid cell. The variability of soil clay content, silt content, sand content, organic matter (OM), pH (soil to water ratio of 1:2.5), electrical conductivity (EC) (soil to water ratio of 1:5) were investigated for all the samples (n=40) and available phosphorous, exchangeable potassium were investigated for selected samples (n=9) by means of classical and geo statistical analysis techniques.

The coefficient of variation of properties ranged from 4% (pH) to 32% (clay content). The experimental variograms calculated for soil properties were best fitted with spherical model. According to the relative nugget effect (RNE -ratio of nugget to the sill) of variograms, the clay content, sand content, silt content, electrical conductivity and organic matter exhibited a highly spatially structured variability (RNE < 25 %), whereas a medium structured variability was observed for soil pH (RNE 25-75 %). The observed spatial dependencies of soil properties indicated that sampling space for future studies can be ranged from 20 m (pH) to 70 m (sand). The maps of texture, OM further illustrated a strong short-scale spatial variability indicating the potential of site-specific soil management in the study area.

COMMUNICATION AND ADOPTION OF WASTE MANAGEMENT PRACTICES OF URBAN AND SEMI-URBAN HOUSEHOLDS IN TRINCOMALEE DISTRICT

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Waste disposal has become a serious issue in Sri Lanka, making her one of the highest waste generating countries in Asia. Previous research findings state that the key to successful waste management system is the cooperation of citizens, which could only be gained through public awareness, which is lacking in Sri Lanka. Thus, the focus of this research was to find out the role communication has in creating awareness and promoting adoption of waste management practices. Moreover, the research specifically focused on finding out the communication channels by which people receive information of waste management and the message content of those channels affecting the level of awareness and adoption of waste management practices.

The data gathered from three purposively selected Divisional Secretariat divisions based on the ethnicity, as the study area is a multi-ethnic area; 200 households were selected randomly from both urban and semi-urban GS divisions. Trincomalee Town and Gravets and Kinniya DS divisions, which are functioning under the urban councils, represent the majority of Tamil and Muslim populations, respectively, whereas Kanthale DS division functions under *Pradeshiya Sabha* represents majority of Sinhala population. Data were gathered using a questionnaire and analyzed using Statistical Package for Social Sciences.

Results revealed that people received messages related to waste management by around 20 communication channels, which can be categorized into three: national mass communication channels, provincial formal communication channels, and informal communication channels. Among them, mostly used communication channel was the television. In addition, respondents used Public Health Inspectors, school education, Urban Council/*Pradeshiya Sabha*, and newspapers to receive information. However, a large amount of information respondents received was not directly related to waste management. The information received through school education, television, newspaper and non-governmental organizations showed a significant positive impact on awareness level, but, only school education had a significant positive impact on adoption level. In conclusion, the results emphasize that communication plays a major role in creating awareness of people regarding waste management. However, it alone cannot contribute to improve the adoption level, which requires the contribution of supporting services, such as the service of informal waste collectors and implementing rules and regulations.

CHEMICAL AND ISOTOPE CHARACTERISTICS OF KIDNEY STONES (URINARY CALCULI) FROM SRI LANKA

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Mineralogical, chemical and isotope characteristics of fifty (50) urinary calculi samples collected from removal surgeries were investigated. Fourier Transform Infrared Spectroscopy (FT-IR) technique was used to determine the mineralogical composition while elements Na, K, Ca, Mg, Zn and Fe in kidney stones were determined using Atomic Absorption Spectrophotometry. Stable isotope ratios of ¹³C and ¹⁸O were measured with isotope ratio mass spectrometer (IRMS). Stone samples were classified into four mineral groups based on FTIR characteristics in which whewellite (calcium oxalate) stones are dominant among apatite, uric acid (uricite) and struvite stones. Apatite stones are enriched with trace elements compared to other stone types in which phosphates act as an important metal-bearing phase. Uricite stones showed the lowest trace metal contents. The $\delta^{13}\text{C}$ of urinary calculi ranged between -34 and -17 ‰ whereas $\delta^{18}\text{O}$ value of kidney stones varies from -8.94 and -26.72‰. Most samples, particularly whewellite and apatite-uricite stones indicated more depleted $\delta^{13}\text{C}$ values (-32 to -34‰). Since the isotopic composition of animal biominerals reflect those of ingested food and water, the more depleted $\delta^{13}\text{C}$ in kidney stones are possibly due to heavy consumption of C₃ dietary components. The isotope fractionation between inorganic reservoirs and biominerals of human body is important to understand the sources of elements in such biomaterials.

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CATION AVAILABILITY IN BUFFERED COIR PITH AND THE EFFECT ON GROWTH OF TOMATO (*SOLANUM LYCOPERSICUM*) PLANT

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Plant growth retardations are often reported when coir based soilless growth media is used in protected agriculture. This has been related to high Na and K concentrations in the coir pith and different buffering techniques have been proposed to rectify this problem. This study determines the cation availability in coir pith buffered with three chemicals and the growth and nutrient status of the tomato plant (*Solanum lycopersicum*) grown in these media. In a leaching column experiment, 0% and 100% of the Albert solution recommended for tomato in protected agriculture was applied into coir buffered with either water, Ca(NO₃)₂, or MgSO₄. Cation concentrations were determined in leachates collected at six times in 42 days. In a greenhouse pot experiment, 0%, 50%, 100%, and 120% of the recommended level of the Albert solution were applied into tomato plants replanted in the three buffered coir medium. Growth and leaf nutrient concentrations of the tomato plants were measured after 42 days. Available Na and K concentrations were the lowest in coir pith buffered with Ca(NO₃)₂ (71 and 91mg/L, respectively) compared to those in coir pith buffered with MgSO₄ (187 and 304 mg/L respectively) or water (138 and 287 mg/L, respectively). This was about 49 to 63% reduction for Na and about 70% reduction for K. When the Albert solution was added, Na availability became high, as high concentration of Ca and Mg in it get strongly adsorbed to exchangeable sites and replace Na⁺. Dry matter accumulation in plants grown in both Ca(NO₃)₂ and MgSO₄ buffered coir was not increased when the Albert solution was increased beyond 50% of the recommended level. But in plants grown in water buffered coir, application of 100% of Albert solution was required to record the highest growth. Multiple regression analysis revealed that the change in phosphorous (78%) and calcium (10%) status of the plant could be the possible reasons for the observed variations in plant growth. The most effective buffer to reduce Na and K in coir was Ca(NO₃)₂ and coir could be used as a growth media efficiently by employing appropriate nutrient management strategies when they were buffered with different chemicals.

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IDENTIFICATION OF SALINITY HAZARD ZONES USING DUALEM-1S PROXIMAL SOIL SENSOR**H.G.K. Hiranthika^{1*}, U.W.A. Vitharana¹ and R.A.C.J. Perera²**¹*Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka*²*Field Crops Research and Development Institute, Mahailuppallama, Sri Lanka***kasunigamage7@gmail.com*

Development of soil salinity is one of the degradation processes that affects soil productivity throughout the world. It is predicted to aggravate in the coming decades endangering food security. In Sri Lanka, soil salinity occurs in major irrigated inland areas of the dry zone and coastal areas. Information on spatial variability of soil salinity and identification of salinity hazard areas are important to apply relevant reclamation measures, to select suitable crop varieties and to minimize further degradation of productive lands. This study focuses on the potential of DUALEM-1S, an electromagnetic induction-based proximal soil sensor to explore the spatial variability of soil salinity and subsequent delineation of potential salinity hazard zones in dry zone paddy soils. Apparent electrical conductivity (EC_a) survey was performed using the DUALEM-1S sensor in a paddy field (2.5 ha) in Mahailuppallama. Top (0-30 cm) and subsoil (30-60 cm) samples were collected at 35 sample locations those identified using the Latin Hypercube sampling technique based on EC_a . Soils were analyzed for pH, EC (1:5 Soil: Water), EC of saturated paste (EC_e), texture, organic matter (OM), available Na, Ca, Mg, and CEC. The EC_a survey resulted in 6318 measurements of horizontal (EC_{aHCP} , subsoil sensitive) and perpendicular (EC_{aPRP} , topsoil sensitive) coplanar coil orientations. Both measurements were highly correlated ($r = 0.95$). The EC_{aPRP} and EC_{aHCP} measurements showed strong correlations with topsoil EC_e ($r = 0.90$) and ($r = 0.89$), respectively. The regression model fitted between EC_e and EC_{aPRP} ($R^2 = 0.8$) showed that latter can be used as a soft information to predict the salinity hazard of the study area. Two potential salinity hazard zones were delineated using Fuzzy k-means classification based on interpolated map of EC_{aPRP} . One zone was having comparatively low EC_a (0.1- 155 mS/m) and the other a higher EC_a (155- 309.9 mS/m). Soils were obtained from each zone for further analysis. Soil analyses revealed that the zone having high EC_a as a sodic zone ($ESP > 90.1\%$) and zone having lower EC_a as a salinity hazard zone. A pot experiment conducted using soils of potential salinity hazard zones revealed a zero germination of Bg 352 and At 354 rice varieties in the sodic zone and the non saline zone did not affect on the germination of both varieties. This study results justified a strong potential of proximal soil sensing for the characterization of salinity development in paddy soils in the dry zone.

ESTIMATION AND MANAGEMENT OF MOBILE PHONE WASTE (M-WASTE) IN SRI LANKA

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Electrical and Electronic Wastes (E-Waste) are generated due to the rapid increase of technology and economic activities in developed and developing countries in the world. Currently, E-Waste shows the fastest growing waste stream of about 4% with comparison to other waste streams. Discarded or obsolete mobile phone wastes (M-Waste) represent the largest proportion of E-Waste stream. In Sri Lanka, demand for mobile phones is relatively high and a recent study revealed that the mobile phone penetration increased from 28% to 40% in past few years.

Therefore, M-Waste management is an urgent requirement in Sri Lanka to protect the environment and public health. There are certain approaches taken to manage M-Wastes in Sri Lanka. National Implementation Plan for electronic waste in Sri Lanka is a part of a pilot project on environmentally sound management of electronic waste in Asia and Pacific. There are some regulations enacted on use and disposal of mobile phones and technical guidelines to manage used lead acid batteries. However, the steps that have been taken to manage M-Wastes in Sri Lanka are not sufficient.

The objectives of this study were to estimate the outflows end-of-life of mobile phones and past and future trends in the generation of obsolete mobile phones in Sri Lanka. A combination of two models was used to achieve above objectives. At the first step, time series multiple life span model was used to estimate outflows end-of-life obsolete mobile phones. Then, the simplified logistic function model was used to estimate the values of obsolete mobile phones in the future. Data were collected from available records, telephone interviews and face to face interviews. Questionnaires were also distributed among people in various levels in the society.

The results revealed that the average life span of a mobile phone is approximately three years and the different types of end-of-life of mobile phones included reuse, store, recycle, throw with other waste, and just open dumping. The percentages of different end-of-life were 50%, 20%, 12%, 11% and 7%. According to the logistic function model, the number of obsolete mobile phones by 2035 will be more than 20 million. The results of the study revealed that the obsolete mobile phones would be a severe problem in Sri Lanka in future. Therefore, it is necessary to encourage investors to implement recycling facilities in large scales to manage the problem of M-Waste in Sri Lanka.

MODELLING THE TEMPORAL DYNAMICS OF SOIL MOISTURE CONTENT OF A YELLOW LATOSOL

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Soil moisture is a key variable that control exchange of water and heat between the land surface and atmosphere. Knowledge on the dynamics of soil moisture and there management are paramount steps to improve crop production. In this study, a simple hydrological model was assessed to estimate the temporal dynamics of soil moisture content of a Yellow Latosol at Regional Agricultural Research and Development Centre in Kilinochchi.

The input parameters required for the model (Chopra model) are initial soil moisture and surface boundary flux conditions along with few easily measurable soil physical parameters. This model also predicted the soil moisture contents at different depth intervals and at different time intervals. To investigate functioning of the model, input data were obtained from available literature databases, laboratory analysis and pedo-transfer functions. Soil samples were collected at the depth of 0-15 and 15-30 cm every morning at same time for a twenty days period from each location for moisture content measurements.

Measured and predicted moisture contents of the surface soil were compared using root mean square error (RMSE) and residual error (RE) values. The result indicated that the RMSE values for modelled moisture content were within the range 0.02 to 0.08 and the RE values from 2 to 8%. When input data from three different sources were used the residual error is less than 10%, which is reported as an acceptable level of prediction accuracy. This model produced most accurate predictions when the values of input parameters from laboratory analysis were used. Hence, this model can be applied to generate temporal dynamics of soil moisture data with an acceptable accuracy for agricultural purposes.

ACTIVATED COCONUT COIR AS Na⁺ AND Mg²⁺ ADSORBENTS FOR DESALINATION APPLICATIONS

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Inadequate supply of safe drinking water is one of the major global issues and desalination of sea or lagoon water would be a plausible solution. Conventional desalination techniques are costly, require large amounts of energy, thus renewable sources of energy or cheaper alternatives should be sought out. This study focuses on the investigation of the potential of laboratory prepared activated coconut coir (ACC) in removal of sodium and magnesium ions from saline water, which could be extended to desalination applications at domestic level. Activated coir is prepared by pyrolysis of raw coconut coir treated with 50% (w/w) phosphoric acid. The adsorption characteristics of synthesized activated coconut coir was determined by measuring iodine number and methylene blue (MB) value of synthesized product and compared with those of commercial samples. Fourier Transform Infrared (FT-IR) spectroscopy indicates the presence of oxygen containing functional groups that are responsible for the adsorption of cations in desalination applications. The X-Ray diffraction pattern indicates the presence of weak graphitic structure in synthesized ACC. Sodium and magnesium ion removal efficiencies are studied using standard NaCl and MgCl₂ solutions. For both Mg²⁺ and Na⁺, approximately 50% removal is observed. For seawater samples, 40% removal of both cations is achieved with ACC dosage of 80.0 g L⁻¹. Repeated filtration studies indicate 72% removal for Mg²⁺ after 6 filtrations and 75% removal for Na⁺ after 10 filtrations from seawater. The equilibrium studies show that the adsorption behavior fits into Langmuir and Freundlich isotherms, implying homogeneous monolayer coverage and chemisorption for both sodium and magnesium adsorption.

Regeneration of spent activated coir is achieved by back washing using distilled water followed by either treatment with conc. HCl (RA – ACC) or pyrolysis (RP – ACC). Regenerated samples are characterized using MB adsorption value and FT-IR spectroscopy. The removal capacity of regenerated ACC have been compared with fresh activated coir by determining percent removal of Mg²⁺ from 0.200 mol dm⁻³ MgCl₂ solution. 52% removal of Mg²⁺ was obtained by RP – ACC indicating its suitability in reuse.

INVESTIGATING THE INFLUENCE OF CLIMATIC PARAMETERS ON RIVER MAHAWELI WATER QUALITY ASSOCIATED WITH LEACHATE CHEMISTRY

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Increased solid waste generation due to rapid urbanization and industrialization is a major problem around the world. Landfilling or open dumping is the most common disposal method of municipal solid waste (MSW) in developing countries. However, majority of these landfills are not properly managed, resulting in contamination of nearby groundwater and surface water bodies by the landfill leachate run-off. In Kandy, the canyon method is commonly used for MSW disposal. In this method, a suitable canyon (depression) has been filled with dumped waste, without taking any measures to prevent or minimize hazards arising from dumped waste. According to the available literature, chemistry of the leachate generated from a landfill is seriously influenced by the climatic parameters. Therefore, the study was conducted to understand the relationship between the climatic parameters and the leachate chemistry and the association of these two factors with the river water quality to ensure the safety of drinking water consumers. Landfill leachate, river water and groundwater samples were collected weekly from the leachate drain of the Gohagoda landfill, four locations along Mahaweli River (two upstream and two downstream points from where leachate drain to the river) and from two wells within the landfill, respectively, for a period of two months. The samples were preserved, stored and analyzed according to the Standard Methods. Daily temperature and rainfall data were also collected from the Horticultural Crop Research and Development Institute, Gannoruwa, and the statistical analysis were performed with MINITAB version 17.0. The study found that the concentrations of components (pH, Biological Oxygen Demand, Chemical Oxygen Demand, Ammonia Nitrogen, Phosphate) in the Gohagoda landfill primary leachate were higher than the recommended standards of tolerance limits for discharge of effluent for inland surface waters by the Central Environmental Authority and most parameters were similar to the values reported in the past studies. According to the results, Total Organic Carbon (TOC) concentration showed significant differences (0.001) at 5 % probability level ($P < 0.05$) in upstream and downstream river water samples leading to conclude that leachate has a negative impact on the river water quality. Apart from TOC, the Pearson Correlation Analysis and the ANOVA on other parameters (pH, Electrical Conductivity, Dissolved Oxygen, Total Dissolved Solids, Phosphate, Nitrate-Nitrogen, Ammonia-Nitrogen, Total Nitrogen, Biological Oxygen Demand, Total Carbon, Total Organic Carbon, Inorganic Carbon, Cadmium) did not show any significant impact of Gohagoda leachate on Mahaweli River water. This is attributed to the dilution effect and few of the leachate parameters were affected from the temperature and rainfall. Therefore, further studies are necessary to investigate the influence of other climatic parameters such as wind pattern and solar radiation on leachate and river water quality.

EFFECT OF BIOCHAR ON PHOSPHORUS AVAILABILITY AND FIXATION IN SOME RUBBER (*HEVEA BRASILIENSIS*) GROWING SOILS OF SRI LANKA

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In most rubber [*Hevea brasiliensis* (A. Juss.) Muell. Arg.] growing soils, phosphorus (P) availability is very low and added P fertilizers become unavailable to the rubber plant due to strong fixation of it into Fe and Al oxide minerals prevalent in these soils. Some studies have observed that amending soils with biochar (BC), a co-product of thermochemical conversion of lignocellulosic materials into advanced biofuels, has increased the P uptake and cut down chemical P fertilizer usage in rubber nursery plants. Therefore, a laboratory incubation study was undertaken to determine the dynamics of soil P availability in three rubber growing soils amended with BC made from rubber wood (RWBC).

Three soil types, i.e. Reddish Brown Latasolic (RBL) soil from *Parambe*, Reddish Brown Earth (RBE) soil from *Thanamalwila*, and Red Yellow Podsolc (RYP) soil from *Payagala* were amended with RWBC at 0, 2 and 5% by weight. The soil moisture content was maintained at 80% of water holding capacity and P availability was determined at 0, 1, and 4 weeks during the incubation period. P fixation of soils amended with RWBC was assessed using the Portch and Hunter (2002) method.

Available P contents were very low (4.1 to 10.7 ppm) in the three soils and was in the order RYP < RBE < RBL. Application of RWBC increased the available P content by 3 to 7 folds and the increase was in the order of RBE < RBL < RYP. The available P content decreased with incubation time and the greatest decrease (52%) was in RBL while the lowest (42%) was in RBE soil at 4 weeks after incubation in 5% BC amended treatments. Among the three soil types studied the RYP soil had the lowest P fixation ability, while RBL was the highest P fixing soil. Application of BC decreased the P fixation in RBE and RBL soils but not in RYP soil. The greatest decrease was observed when RWBC was applied at 5%. Therefore, amending rubber growing soils with RWBC appears to have altered the dynamics of available P in a positive manner.

EVALUATION OF THE STATUS IN ENVIRONMENTAL FLOW MAINTAINANCE AT MANGALATHIRIYA ANICUT IN ATHTHANAGALU OYA, SRI LANKA

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Determination of the volumes of flows that should be maintained for the sustenance of the natural eco systems under pristine conditions (Environmental Flows [EF]), remains complicated and difficult, causing a challenging situation for the sustainable management of water resources in many countries. As a tropical developing country with agriculture based economy, Sri Lanka is in need of utilizing the available lentic and lotic water sources heavily to support its economy. Yet, the management of such water sources in an ecofriendly sustainable manner without significantly affecting, both the environment and the economy, requires the maintenance of environmental flows. Thus, the quantification and long-term maintenance of EF requirements of lotic waters has emerged as a crucial requirement in sustainable management of water resources. Therefore, the Range of Variability Approach (RVA) was devised to evaluate the sufficiency of the flows at the downstream of the Mangalathiriya anicut for the sustenance of downstream riverine ecosystems. The Hydrologic Engineering Centre - Hydrologic Modelling System (HEC-HMS) version 3.5 model was calibrated and validated for the Aththanagal Oya catchment and the daily river flow values for the past twenty years (1994-2014) were generated at the pre weir of the Mangalathiriya anicut. The downstream flows were calculated by deducting the drinking water requirements of the anicut. The existing flow regime at the post-weir was subjected to a RVA analysis, while utilizing 32 different hydrological parameters. The RVA targets (set based on the flows of pre weir site) and rate of non-attainment (for the flow at the downstream of the weir of Mangalathiriya anicut) were calculated to evaluate the sufficiency of the downstream flow regime to cater the EF requirements of downstream ecosystems. The rate of non-attainment of the IHA group 1 and group 2 parameters range in between 33 - 100 % suggesting a moderate to severe level of ecological degradation of the downstream ecosystems. In the IHA group 3, inability of calculating the timing of lower limit of annual extreme water condition due to the prevalence of similar minimal flow levels for several days forced the annual minima to be left uncalculated. Yet the annual maxima reflect a rate of non-attainment of 43 %, while the rate of non-attainment of both IHA group 4 and 5, range in between 48 - 100% and 53 - 100 %, respectively suggesting an ecological degradation of moderate to severe degree. Furthermore, the mean rate of non-attainment of 57.15 % predicts an overall moderate degree of ecological degradation of downstream ecosystems due to the operation of the Mangalathiriya anicut of Aththanagal Oya. Thus, the results of the current study emphasizes that an adequate level of EF regime is not maintained at the downstream of the Mangalathiriya anicut in Aththanagal Oya in accordance with the RVA.

Not Presented

SOIL MOISTURE RESPONSE TO CONVECTIVE RAINFALL

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The climate of Sri Lanka is tropical monsoonal with a marked seasonal rhythm in rainfall. This rhythm is also reflected in the soil moisture because rainfall influences the soil water content. Soil moisture is known to play an important role in our environment and is thus considered an important climatic variable. Therefore, determining the relationship between soil moisture and rainfall are needed to characterize the climate variability. The usual practice is to use long term measurements of rainfall and soil moisture content to derive rainfall-soil moisture relationships. However, results obtained from long-term can obscure the short term behavior of a soil. High temporal resolution rainfall and soil moisture data from first inter monsoon season are used to investigate the response of soil moisture to individual rainfall events.

High temporal resolution data are collected at the weather station of the Department of Geography. The moisture sensor is buried at 30 cm depth to capture the soil moisture in the effective root zone. The soil moisture variations during rainfall were investigated for April 2015. The study focuses on the response of soil moisture to individual rainfall events of different magnitudes and durations. There were 20 major rainfall events during the study period. An individual rainfall event and its corresponding moisture curves were observed. About 45% of rainfall events in April lasted for less than 30 minutes while 30% of the showers lasted for over an hour. In many cases, the peak rainfall occurred about 15 minutes after the beginning of a shower. High rainfall amounts usually triggered a peak in the soil moisture curve. The maximum observed soil moisture level was about 47%. Two types of soil moisture peaks were identified in the time series: sharp-pointed peaks and flat topped-peaks. The latter condition occurred during very long rainfall and/or large rainfall magnitudes. The soil moisture level at the beginning of the month of April was about 2.8%, but thereafter it did not fall below 6% during the rest of the month. This increase in minimum soil moisture level is most likely due to the cumulative effect of rainfall. Although approximately 35% of the showers had total rainfalls of less than 10 mm, the remainder of showers had higher rainfall amounts. These episodes were responsible for maintaining higher soil moisture levels and even driving the soil moisture to the saturation level.

This study reveals that a small rainfall amount with a long duration or large rainfall amount with short duration can lead to soil water saturation. Most of the rainfall events were short (< 2 hours) and a majority of them (60%) occurred in the afternoon suggesting convective rainfall. The study reveals that approximately 15 mm of total rainfall is necessary to get soil moisture to saturation. This implies that rainfall duration is a critical factor in driving the soil moisture to saturation. It is apparent that rainfall duration of less than 30 minutes does not lead soil moisture to saturation. Frequent intermittent rainfall events during the month of April contributed to the overall increase in the soil moisture level compared to the previous month. This elevation in the soil moisture level could also have a significant impact on plants.

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PRELIMINARY STUDY ON USE OF ACTIVATED COCONUT COIR AS ADSORBENT FOR REMOVAL OF CHLORIDE AND FLUORIDE IN WATER

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Chlorine is a powerful germicide used in killing many disease-causing microorganisms in drinking water and reducing them to almost non-detectable levels. However, it can react with organic matter in the water and form dangerous, carcinogenic trihalomethanes if present in excess. Fluoride has beneficial effects on teeth at low concentrations in drinking-water, but excessive exposure to fluoride in drinking-water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects. This is a preliminary study to investigate the ability of activated coconut coir (ACC) to remove Cl⁻ and F⁻ anions in water. Coconut coir, a lignocellulosic polymer, was activated by treating with phosphoric acid followed by pyrolysis and used as an adsorbent for the removal of Cl⁻ and F⁻ anions from an aqueous solution. Activated product was characterized by Fourier Transform Infrared (FT-IR) Spectroscopy, Scanning Electron Microscope (SEM) and X-ray diffraction techniques and adsorption capacity was measured using methylene blue number. Chloride and fluoride ion removal ability of activated coconut coir was studied by using standard salt solutions of KCl and NaF, respectively. The concentration of Cl⁻ was determined using chloride ion selective electrode and that of F⁻ using SPADNS (sodium-2-(parasulfophenylazo)-1,8-dihydroxy-3,6-naphthalene) reagent. After activation, coconut coir gains more porosity and adsorption capacity. This can be attributed by the high Methylene Blue (MB) number of 331.30 mg g⁻¹ obtained for ACC. The FT-IR data indicates appearance of new functional groups such as carboxylate and phosphate after activation process. The Powder X-Ray Diffraction pattern of synthesized ACC sample showed a peak at an angle of $2\theta = 24^\circ$ corresponding to the hexagonal graphitic carbon structure of (002) plane. The surface morphology and pore structures were analyzed using SEM; SEM images of activated product showed pores in the nanometer size scale. The Presence of nanometer size pores introduces higher adsorption capacity into the ACC. The maximum percent removal of Cl⁻ observed was 30% and that of F⁻ was 40% in single filtration. The equilibrium adsorption studies of Cl⁻ and F⁻ anions show that experimental data fits well to linear forms of both Freundlich and Langmuir isotherms implying homogenous and monolayer coverage. The Langmuir constant for Cl⁻ was 388.00 dm³ g⁻¹ and that for F⁻ was 420.00 dm³ g⁻¹. The Freundlich constants for Cl⁻ and F⁻ were 0.022 dm³ g⁻¹ and 0.012 dm³ g⁻¹, respectively. The phosphoric acid activated coconut coir has the potential to be used as low-cost adsorbent for the removal of Cl⁻ and F⁻ anions from water.

ASSESSMENT OF GREEN SPACE IN THE COLOMBO CITY LIAISONS WITH GIS AND IN-SITU DATA

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Urban sprawl in Colombo City is increasing due to centralization of social and economic endeavors. Urban forests and green infrastructure make the city cleaner and healthier to raise the standard of environment quality and aesthetic beauty. This study examines the green urban space in Colombo City using geographic information system and green cover was compared with in-situ ground truthing data in selected locations. A supervised learning algorithm was adopted to classify ESRI base image to three major land-use/cover classes: green space, built-up and water using training samples within Colombo City. Landsat 8 satellite imagery that acquired on 14.04.2015 was used to calculate Normalized Difference Vegetation Index (NDVI). Then green space of the NDVI image was extracted using polygonal vector feature class of the classified image. The results showed that 29% of the area was green space, 67% was built-up and 4% was water. Coefficient of agreement (Khat) was calculated for the classified image resulting in 0.81 overall accuracy. The NDVI values showed the intensity of greenness of vegetation. The difference of NDVI values were compared using available base maps. Then NDVI results were utilized to assess the green space in the field systematically to gauge how species contributes for varying greenness. The results and the method adopted in this study eventually provide valuable insights for city planners and policy makers to establish new green urban space to uplift environmental quality of potential sites in Colombo City.

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**APPLICABILITY OF COLORIMETRIC ORGANIC MATTER
DETERMINATION AND ITS RELATIONSHIP WITH TOTAL SOIL
NITROGEN FOR SELECTED SOILS IN SRI LANKA**

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Soil Organic matter determination using Colorimetric determination is a simple and less time consuming method which has not been tested for Sri Lankan soils yet. Soil Organic matter determination using Walkey and Black method (Volumetric determination) is a very common method. It is more laborious, time and chemical consuming. Relationship between soil Nitrogen level and colorimetric soil organic matter content is also useful to predict soil Nitrogen level. The objectives of this study were to investigate the applicability of colorimetric determination of soil organic matter to Sri Lankan soils and to investigate the relationship between soil Nitrogen and soil organic matter.

Fourteen soils, varying in C content, were collected from agricultural fields at 0-30 cm depth differing in physico-chemical and other characteristics. In colorimetric method, 1 g soil samples were placed in 100 ml volumetric flasks followed by the addition of 10 ml of 1/6 N K₂Cr₂O₇ and 20 ml of concentrated H₂SO₄. The samples were mixed by swirling the flask and then allowed to stand on a pad for 30 minutes in a fume cupboard. After bringing to a volume of 100 ml, the mixture was filtered and analyzed for light absorption at 600 nm using spectrophotometer. Colorimetric organic matter values showed strong correlation with organic matter determined by volumetric (Walkey and Black, 1934) method ($r=0.95$). Organic matter determined from both methods showed no significant difference. Colorimetric method organic matter values showed strong correlation with total Nitrogen ($r=0.75$). It is confirmed that colorimetric method can be used effectively and reliably to determine soil organic matter in Sri Lankan soils and total Nitrogen in soil can also be predicted.

CLIMATE CHANGE ADAPTATION PRACTICES IN CROP CULTIVATION: CASE STUDY IN ANURADHAPURA DISTRICT

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Climate change, mainly the variation in rainfall in the recent past years, causes frequent floods and drought in many districts in the country. The variation in rainfall and frequent floods and droughts affect the crop cultivation, and thereby challenging the food security of the country. Further, it affects the livelihood of the farming community in the tank based agriculture systems which includes the major and the minor irrigation tanks. Many minor irrigation tanks receive water from rainfall, store and supply for agriculture during non-rainy season. Very often the water stored in the minor irrigation tanks is not sufficient to fulfill the water requirement for agricultural purpose, because of the limited tank storage. The objective of this study was to identify the adaptation measures practiced by the farmers to overcome the effects of climate change due to rainfall variation under minor irrigation tanks.

Since Anuradhapura district lies in the dry zone of Sri Lanka and many small and marginal farmers involved in crop cultivation, it was selected for this study. Stratified random sampling was done to select 150 farm households from 15 minor irrigation tanks in Anuradhapura district. Primary data from the farm households using structured questionnaire and the rainfall data for the past 31 years from the year 1984 as secondary data from the Meteorology Department were collected for analysis. Percentage analysis and the graphical representation were carried out using MS Excel. During 1984 to 2014 the average annual rainfall was 1293 mm with a coefficient of variation of 22 percent.

The rainfall was above normal in 13 years with a deficit in 13 years, and very scarce in five years. The survey revealed that the crop insurance, cultivation of short duration crops, cultivation of drought tolerant rice varieties, inter cropping, changing the planting and harvesting date and agro forestry were some of the adaptation strategies practiced by farmers in the study area. The percentage analysis revealed that 94% of the farmers had crop insurance, 90 % of the farmers cultivated short duration crops, 72% of the farmers switched to cultivation of drought tolerant varieties, 46% of the farmers practiced intercropping, 30% of the farmers changed the planting and harvesting date, and 28% of farmers practiced agro forestry strategy as adaptation measures for climate change. Though the farmers in the study area practiced these climate change adaptation strategies to some extent, dissemination of knowledge about appropriate adaptation strategies towards farming community is essential to protect the livelihood of the farm households, while ensuring the food security of the country. Thus, the farmers may be given proper support by supplying short duration and drought tolerant rice varieties and selected seedlings for agro forestry.

DECOLOURIZATION OF CRYSTAL VIOLET SYNTHETIC DYE FROM AQUEOUS SOLUTION BY WOODY BIOCHAR

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Colour removal from textile effluents prior to their disposal is an emerging concern due to its adverse effects on the environment and public health. Biochar can be used effectively as a biosorbent for removal of dye contaminants. This study investigated the adsorption of a basic dye, Crystal Violet (CV), from aqueous solutions on to biochar derived from *Gliricidia sepium* pyrolysed at 700 °C (GBC700). Pyrolysis was done under a heating rate of 7 °C min⁻¹. The adsorption process was investigated through batch experiments by varying pH, adsorbent dose, initial dye concentration, and contact time. The sorbent dosage, initial dye concentration and contact time were set as 0.5 - 6.0 g L⁻¹, 5 - 200 mg L⁻¹ and 5 min - 24 hr, respectively. The effect of pH was determined through edge experiments at pH 3 to 9. The equilibrium data was analyzed using the Langmuir, Freundlich and Hill isotherm models. Pseudo first order, Pseudo second order and Elovich kinetic models were used to investigate the kinetic data.

Results indicated that the optimal adsorbent dose was obtained at 2 g L⁻¹ and the optimum contact time was 12 hr. The adsorbed amount was increased from 5.5 mg g⁻¹ at pH 3 to 8.0 mg g⁻¹ at pH 9 while the equilibrium was reached at pH 7. Since higher pH conditions lead to increasing the negative charge density of GBC700 and the electrostatic attraction to the dye cations can be enhanced. Crystal Violet removal efficiency was 99% at 20 mg L⁻¹. According to the Langmuir model, maximum adsorption capacity was observed at 30.4 mg g⁻¹ at 30 °C. The experimental data fitted well with the Freundlich isotherm model ($r^2 = 0.9788$) and Pseudo second order kinetic model ($r^2 = 0.9703$) which suggests the importance of multilayer adsorption to heterogeneous sites in biochars.

The adsorption process is highly pH dependent. Crystal Violet molecule may interact with the GBC700 through the mechanism of π - π electron donor-acceptor interactions between the π -electron rich graphene surface of biochar and π -electron deficient CV dye molecule. The use of *Gliricidia* biochar pyrolysed at 700 °C could be a sustainable solution to remove CV in aqueous media while compromising the waste problem by using *Gliricidia* byproduct.

FORECASTING INTERNATIONAL TOURISM INCOME OF SRI LANKA: TREND ANALYSIS

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Growth of the tourism industry in Sri Lanka shows the historical development mainly in two ways. That is the growth of tourist arrivals and income. Tourism impacts on the economy of Sri Lanka, which rely heavily on foreign exchange earnings. This has been a general interest of the government. Therefore, the government needs reliable forecasting to cope with uncertain situations and developing sound strategies to maintain the growth of tourism industry. This study was focused on identifying an appropriate trend model for forecasting international tourism income of Sri Lanka.

Monthly income data from 2009 to 2013 were obtained from statistical reports of 2012 and 2013 of Sri Lanka Tourism Development Authority (SLTDA). The study concerns the period of post-war, which is after the year 2009. Model fitting was done by utilizing data from January 2009 to April 2012 and data from May 2012 to May 2013 were utilized for model verification. Four trend models were tested with log transformation including one linear and three nonlinear models. Residual plots and Anderson-Darling tests for residuals were used as the model validation criterion. Forecasting ability of the models was assessed by considering Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE) and Mean Absolute Deviation (MAD).

Box and whisker plot showed no outliers in the data set. Results revealed that Quadratic Trend Model has least MAPE's in model fitting and verification: 0.90% and 1.12 %, respectively. MAD and MSE also confirmed the smallest deviation compared with other trend models. Residual plots and Anderson-Darling test confirmed the normality of residuals. Also, residuals Vs fits confirmed the independence of residuals.

It was concluded that the Quadratic Trend Model with log transformation is suitable for forecasting international tourism income in Sri Lanka. Monthly income for the period from May 2012 to November 2013 were forecasted by the model and found them close to the actual income.

It is recommended to try other time series techniques, namely, decomposition techniques, Auto Regressive Integrated Moving Average (ARIMA) models etc., to capture the seasonal behavior of the series.

UNEMPLOYMENT, OFFICIAL ECONOMY AND DIMENSIONS OF THE SHADOW ECONOMY: AN EMPIRICAL ANALYSIS FOR SRI LANKA USING SEM APPROACH

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Economists and policy makers confront a series of issues when accounting all unobserved market fractions in a challenging market economy. These challenges have become worse within complex market structures in developing economies. One of these challenges is the expansion of unobserved and unofficial economic activities which is generally known as the 'Shadow Economy'. This study basically attempts to estimate the Sri Lankan shadow economic activities as a percentage of official estimates, while revolving the wheel of non-clarified zones and market functions through overstepping the traditional official estimates.

Objectives of the study are addressed through three equally important portions. Initial portion intend to choose and develop suitable, fitted MIMIC (Multiple Indicator Multiple Cause) models while using the structural relationship between the unemployment rate and shadow economy to estimate the size of the shadow economy in Sri Lanka. Then the following portion is to estimate shadow economy for each fitted model through benchmark calculations. Finally, to examine if estimated models and their calculations are accepted by re-examination of Okun's law and to contrast estimated results in growth terms to the growth of official estimates (GDP) of the economy. Therefore, the methodology involves the estimation of structural equation models, which analyses a set of causes of the shadow economy while simultaneously taking in to account its influence upon a series of indicators. This study introduces three MIMIC models through the analysis that are MIMIC 5-1-2a, MIMIC 4-1-2b and MIMIC 3-1-3a. Then the benchmark calculations for each model derives a series of average values for the Sri Lankan shadow economy from 1990-2012. Calculations for MIMIC 5-1-2a vary between 91% and 32% from 1990 to 2012 with a decreasing trend. On the other hand, calculations for MIMIC 4-1-2b and MIMIC 3-1-3a demonstrate the average size of shadow economy between 14% and 52% with an increasing trend.

Further discussions, therefore, reveal the fact that, the effect from tax on goods and services to the government revenue and the effect from public employment tend to undermine the increasing pattern of shadow economy in Sri Lanka. Since unemployment rate and private employment plays a major role in economy, shadow economy tends to increase. Eradicating the workplace enforcement crisis and underemployment issues may hinder the increasing pattern. Ultimately, the results from re-examination of Okun's law give a hint that the growth of shadow economy and official economy are not interdependent and have a parallel growth with shifting stages in market functions.

Not Presented

THE IMPACT OF CORPORATE SOCIAL RESPONSIBILITY (CSR) ON BRAND EQUITY: A STUDY WITH SPECIAL REFERENCE TO SRI LANKA TELECOM PLC

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Today, Investment on Corporate Social Responsibility (CSR) has become the common business practices in the world. CSR is receiving increasing attention, especially in recent decades. At the same time, various stakeholders, especially, shareholders are more frustrated with the investment on the Corporate Social Responsibilities which will affect indirectly to the Brand Equity of the organization. Further there are various pros and cons about CSR, which impact the brand equity of the organization. Sri Lanka Telecom PLC (SLT) is the blue chip company in which CSR has become the most common practices in the SLT business agenda. The SLT has invested on CSR aspects. It is found that there are only few researches have been carried out in Sri Lankan context to find out the impact of CSR on brand equity and there is a need to measure it for organization's effective CSR decision makings. The major objective of this research is to explore and investigate how a company's corporate social responsibility activities are influencing its brand equity. By reviewing the existing literature on CSR and brand equity of the SLT, this study developed a better understanding of gaps that exist. In order to achieve the objective, the research draws from well-established theoretical models; the Carroll model which presented four variables on CSR. This model has been used by many researchers to measure the CSR activities of firms. According to this model, there are four perspectives such as economic, social, legal and ethical perspectives and the Aakers' model has been used to measure the brand equity. The research adopted quantitative method to explore impact of CSR on brand equity of the SLT and data were collected by means of online survey tool and printed questionnaires. A survey was conducted among 100 customers who use the SLT services. Regression and correlation analysis, including partial correlation, linear, binary logistic regression, was used to obtain the results that helped identify the impact of CSR on brand equity of the SLT. The results of the study showed that corporate social responsibility is positively impacted on brand awareness, brand loyalty, perceived quality and brand association of the SLT PLC. Thus there is a positive impact of CSR on brand equity and if the SLT invests more on CSR activities, the value of their brand equity will be increased.

MOBILE PHONE AS A MODE OF INFORMATION PROVIDENT TO UP COUNTRY VEGETABLE FARMERS IN SRI LANKA

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This study explores the status of mobile usage as a mode of providing information to the agriculture community in the upcountry region in Sri Lanka. The objectives of the study were to find out the awareness level, usage, attitudes of upcountry vegetable farmers about the mobile phone based information systems and services, to find out the factors affecting on mobile usage by farmers and their willingness to pay for mobile phone based information systems and services. Primary data were collected using an interviewer administrated questionnaire (n=120).

Findings reveal that the access to mobile phones was considerably higher among the study group, while income had an effect on using a mobile phone. Most of the farmers use mobile phones to communicate with family, friends and relatives. Only few farmers use them effectively to obtain agriculture related information. Awareness and usage of mobile phone based information systems and services are at a lower level. Attitudinal barriers and less awareness are the major reasons for this situation. There is a positive relationship between the usage of mobile phone based information systems and services and farmers attitudes on its impact on knowledge and income. Farmers who are using the mobile phone based information systems and services highlighted that the services are very much helpful for agriculture development.

IDENTIFYING IMPACT OF WORK LIFE CONFLICT ON JOB SATISFACTION

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Ceylon Electricity Board (CEB) is a body corporate for electricity undertaking in Sri Lanka. It conducts its massive duties to the Sri Lankan public through Generation, Transmission, Distribution and other services. One of the major problems that the results of pilot survey has revealed is that, among the CEB workforce many of non-executive staff in CEB-Sabaragamuwa are facing problem of work life conflict. At present the conflict between work and family has become a crisis for organizations. With the increase in dual family parents, more job demand and long working hours made it almost impossible to create a balance between work and family. This situation automatically reduces job satisfaction of the employees and then affects the productivity and profitability of the organization. The overall objective of this research was to analyze the factors related to work life conflict and its impact on job satisfaction at the CEB-Sabaragamuwa Provincial Office. The data were collected by distributing a questionnaire and the sample has comprised 120 non-executive employees. Pearson correlation test and Regression analysis were utilized as data analysis techniques. The results revealed that work life conflict impacts on reducing the job satisfaction. Further, family to work conflict could be identified as the most critical predictor. Ultimately work life conflict of non-executive staff employees of CEB negatively impact on their job satisfaction. The relationship between work life conflict and job satisfaction is inversely related to each other.

Not Presented

IMPACT OF PER CAPITA INCOME AND HUMAN CAPITAL ON INCOME INEQUALITY: AN EMPIRICAL ANALYSIS

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The relationship between income inequality and per capita income growth cum human capital in the literature is puzzling. Even though by the mid-nineties, there existed a substantial body of empirical research that suggested that there was a negative effect of economic growth on income inequality the researchers continue to make efforts to understand whether this effect is true for any stage of economic growth. This study uses a modified Random Effect Panel data model to estimate the impacts of Per Capita income and Human Capital on income inequality. As the primary objective, the impact of per capita income growth on income inequality is measured, and then the impact of Human Capital on income inequality is tested as the secondary objective. Study uses average years of Schooling data as proxy to calculate the Human Capital improvement over time. The sample covers 140 countries from 1971 to 2010. To reduce the cyclical serial correlation the data are averaged to five year periods.

Panel data Random Effect estimations generated several significant and interesting results. Per capita income shows a positive but weakly significant impact on Gini Coefficient and among other variables openness of economy is positively significant at 1% confidence level. The literature also explains that this relationship has mixed results. Therefore, this research provides strong platform to support the *Kuznets* agreement, increasing the per capita income that will reduce the income inequality over time.

As the second objective human capital impacts on the income inequality was tested using average years of schooling in primary, secondary and tertiary levels. Primary schooling provides strong evidence in support of reducing the Gini Coefficients over time. But secondary school education does not support to reduce the Gini coefficient values in the same way. Thus, primary school education is highly productive since reading and writing lead workers to be highly productive in their daily economic activities. They will support to the agricultural and industrial sectors as workers who perform in manual labor. But the secondary and tertiary schooling has much higher social cost than private benefits. Therefore, the higher education will not support directly to reduce the income inequality and that was represented by the significant but positive relationship with income inequality.

The model is finally restricted to developing economies using dummy variables. The estimated results show that South Asia, Middle, Central Asia, and specially transitional economies have failed to achieve significant results. However, the rest of the developing world can use education and per capita income growth measures as income inequality reducing tools.

PSYCHOLOGICAL AND BEHAVIORAL VARIABLES AND ACQUIRED COMPETENCIES IN SUCCESSFUL ENTREPRENEURSHIP IN SRI LANKA

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When growing as an entrepreneur a range of challenges have to be faced. As a business grows, different opportunities demand different solutions. Success of the entrepreneur depends mostly on how the entrepreneur faces the challenges such as strengthening the overall economy, taxes and regulations, cost and availability of insurance, attracting and retaining a quality workforce, global competition and etc. Entrepreneurs must possess self motivation that pushes them to make their business dreams a reality. Entrepreneurs need commitment to reach the goals. This study shows how psychological and behavioural status and acquired competencies of entrepreneur affect to his success of the business through questionnaire survey. Also it is assumed that the other factors other than psychological and behavioural status and acquired competencies which affect on to success of the entrepreneurs are constant. This research basically depends on primary data, which were collected through a questionnaire survey and interviewing of a sample of entrepreneurs. Secondary data is derived by paper articles and television interviews of entrepreneurs. Sample size of the questionnaire survey was 80 and the response rate was 22.37 %. Also it is considered that the successful entrepreneurs are the one whose monthly income is above Rs.500,000.00 in Sri Lanka. The collected data were analysed with the help of SPSS package to get conclusion. The results revealed that there is a significant impact of psychological factor (34%), behavioural variables (39%), acquired competencies (12%) and other variables (15%) on a success of an entrepreneur. According to the analysis the empirical result confirms that there is a strong relationship between psychological and behavioral variables and acquired competencies of and the financial performance of the business. This study attempted to examine the relationship between psychological and behavioural status and acquired competencies of the entrepreneur with his success of the business. In essence it proves, if the entrepreneur is mentally and behaviorally stable and he has his own strengths to move forward, none of the external impacts can stop his success.

VOLATILITY SPILLOVERS BETWEEN COLOMBO AND OTHER REGIONAL STOCK MARKETS

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This study aims at exploring the volatility spillover effects between Colombo and two other stock markets in South Asian region: Karachi and Mumbai. Using daily data over the period between 2nd January 2004 and 23rd September 2014, a trivariate BEKK-GARCH(1,1) model has been employed to capture possible volatility spillover effects between Colombo and two other markets. Due to the asynchronous trading sessions between countries, in analyzing volatility spillovers, daily market returns were decomposed into two fragments, namely intraday and overnight. The study offers some important findings. There exists evidence for bidirectional intraday spillovers between Sri Lanka and India as well as Sri Lanka and Pakistan. It is also evident that the spillover effect from Pakistan to Sri Lanka is stronger than the spillover effect from India to Sri Lanka. However, the volatility spillover effect from Sri Lanka to India is stronger than the same effect from Sri Lanka to Pakistan. When it comes to overnight returns, no volatility spillover effects exist between Sri Lanka and Pakistan in either direction. Though overnight volatility spillover effects exist between Sri Lanka and India, such effects are unidirectional from Sri Lanka to India.

AN EXPLORATION OF AUDIT COMMITTEE COMPOSITION AND ROLES IN SRI LANKAN LISTED COMPANIES

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Audit Committee has been identified as a key mechanism within a firm's governance structure. Following content analysis of annual reports, this study investigates the status of compliance of the audit committee with the corporate governance regulation in an emerging economy of Sri Lanka. The effectiveness of audit committee as a corporate governance mechanism seems to depend on its composition and role. The findings demonstrate a strong compliance with most of the corporate governance principles stipulated in the codes of best practices of corporate governance. For instance, the size of the audit committee varies from three to five members with averages of 97.78 and 82.89 percents being non-executive and independent directors, respectively. All companies have at least one expert in finance and also on average, 53.7 percent members have expertise knowledge on accounting or auditing. Number of meetings varies from two to twelve with an average of five meetings per annum, which exceeds the minimum statutory requirement of four meetings. The study also reveals that independence, expertise, qualifications, experience and attendance of the audit committee members have been increased over time between 2008 and 2013. But, certain audit committee practices appear to markedly deviate from best practices. For example, only 10 percent of the companies have the internal auditor acting as the Secretary to the audit committee. In addition, while all chairpersons of the audit committees are entirely non-executive directors 13 percent of them are not independent. Moreover, the analysis of the role of the audit committee based on what it reports finds that more attention was paid on financial reporting, and external and internal auditing, while risk management and control have been given a less weight. This study contributes to the existing literature by providing greater detail on current practices related to audit committees in an emerging economy focusing on their level of compliance with the existing listing rules and best practices.

**DETERMINANTS OF VOTING RIGHTS PREMIUM IN
THE BANKING, FINANCE AND INSURANCE SECTOR:
EVIDENCE FROM THE COLOMBO STOCK EXCHANGE**

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This study examines the factors which determine the voting rights premium. Traditional finance theory disregards the value of voting rights in pricing common stock. This would not be harmful in most situations however in circumstances where companies issue dual class of shares i.e., voting and nonvoting, the voting shares would have a superior value compared with the nonvoting shares due to the overriding voting privilege.

The study of voting premium would be concentrated mainly on the Bank, Finance and Insurance Sector of the Colombo Stock Exchange (CSE). There has been no previous study done to determine the factors that affect the voting rights premium. However, based on empirical studies conducted in other countries, the voting rights premium ranges from a larger premium of 82% to voting discount of 3%.

The voting premium varies according to the ownership structure and the concentration of voting rights. The research has used only secondary data for the purpose of analysis. The data were extracted from the quarterly financial reports from the CSE. Only 4 data points for each company per year were available from public sources since the changes in other independent variables were not available as these were reported only 4 times per year. The findings of the study were voting premium has a moderate strong relationship with the fraction of voting shares. Furthermore, the premium has a negative relationship with the public float, major shareholder and fraction of voting shares and a positive relationship with the second major shareholder and Relative Shapley Value (RSV).

THE IMPACT OF EMOTIONAL INTELLIGENCE ON JOB PERFORMANCE AND JOB SATISFACTION OF BANK MANAGERS IN SRI LANKA

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The literature suggests that organizations are fast realizing that traditional intelligence or Intelligence Quotient (IQ) are not merely sufficient for developing job performance, work-related behaviours and career advancements of leaders in organizations. The managers are expected to show their worth in creating conditions in which people can deliver the best results necessitating mastery of a set of new key competencies which includes emotional intelligence and related competencies. However, research to identify the impact of EI on job performance and job satisfaction is very limited. Hence, the purpose of this study was to investigate the effect of emotional intelligence on the job performance and job satisfaction of bank managers in Sri Lanka.

Based on the literature a conceptual model was developed. The study adopted already validated research instruments. The model was empirically tested by collecting data through structured questionnaire, from commercial bank branch managers including private and state banks in Sri Lanka. Total of two hundred commercial bank managers were selected for the study using the convenience sampling technique and one hundred and sixty three usable questionnaires were received. The model was tested with the measurement model and the structural model analysis by using Partial Least Square technique (PLS) through the software of Smart PLS version 2.0. The measurement model analysis was used to establish the item reliability, internal consistency reliability, convergent validity, and discriminant validity and the structural model analysis was used to determine the model's explanatory power and to test the hypotheses formulated based on the cause-effect relationships between constructs.

The structural model analysis results provided the support for all three hypotheses formulated in this study (The higher the level of emotional intelligence of bank managers, the higher the levels of job performance, and higher the levels of job satisfaction). Results indicated that that the bank managers with higher levels of emotional intelligence are likely to display higher job satisfaction and job satisfaction in the workplace. This study provided future directions for further research as well.

IMPACT OF FIRM SPECIFIC FACTORS ON STOCK PRICES: WITH SPECIAL REFERENCE TO DIVERSIFIED HOLDING COMPANIES IN COLOMBO STOCK EXCHANGE

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Many of empirical studies have been carried out in order to find out the factors that affect stock prices. Previous studies have revealed that movement of stock prices depends on both internal and external factors. The primary objective of this study is to analyze the internal factors or company specific factors that influence in determining the share price of companies listed in diversified holding sector of Colombo Stock Exchange (CSE). The study focuses on impact of growth, liquidity, profitability, leverage and dividend aspects of diversified holding companies on their stock prices. Those indicators were measured using variables such as earning per share, current ratio, return on equity, debt to equity ratio, dividend per share, respectively.

Secondary data collected from annual reports of each company for the period of 2008 to 2014 were used for the data analysis. There are 19 listed diversified holding companies in CSE, out of which nine companies were selected for the study based on the data availability. Multiple regression analysis model was used to find out the relationships and for examining the impact of selected variables on stock prices. The fitted regression model revealed that there is a strong relationship between independent variables and stock price.

Finding of the study revealed that the earnings per share is the significant variable in deciding the market value of shares and it is significant at 1% level with the statistic of 8.305. Further, dividend per share, current ratio, return on equity and debt to equity ratio are insignificant variables when deciding the market value of shares. All these variables have t statistic less than its benchmark value of 2. Therefore, as per the findings of this study it is suggested that earnings per share is the most influencing factor in determining the market value of the shares of the diversified holding companies in Sri Lanka and investors should give more attention. Further R^2 value stands for 67.6, which indicates that 68% of variation in stock price is explained by earning per share, current ratio, debt to equity ratio and dividend per share. F statistic value of the model indicates that the overall model is significant at 1% level.

CURRENCY DEPRECIATION AND J-CURVE ANALYSIS: A CASE STUDY BASED ON SRI LANKA

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The fluctuations of foreign exchange rates affect many economic activities all over the world. Currency depreciation or currency devaluation directly affects to decrease imports and increase exports. As a result, trade balance will be favorable. Currency devaluation immediately raises the domestic price of imports. The quantities of imports and exports do not adjust immediately. Therefore, trade balance deficit increases in the short run. As time passes, the quantity of imports falls and quantity of exports rises. Eventually, the trade balance moves towards a surplus. This type of a system can be called as a J curve.

Sri Lanka as a country which has earned a great deal of international attention needs to address the long-lasting trade deficit problem. However, no studies have been conducted to examine the effect of currency depreciation (SL introduced freely floating exchange rate system in 2001) on bilateral Trade Balance (TB) between SL and her main trading partner India using J curve analysis.

The main objective of this study is to identify the impact of foreign exchange rate (expressed as direct quotation) which was introduced in 2001 on trade balance of Sri Lanka and to examine whether there is a bilateral J curve effect between Sri Lanka and India. This study covers the time period of 2002.Q1 – 2013.Q4. Data were collected from annual reports of Central Bank of Sri Lanka and Department of Census and Statistics. The results have been analyzed through Johansen Co-integration Test, Vector Error Correction Model (VECM) and Generalized Impulse Response Function (GIRF).

Johansen Co-integration Rank Test has detected one Co-integration relationship which confirms a significant long-run relationship among the variables and showed a positive relationship between Exchange Rate and Bi-lateral Trade Balance in the long-run. According to the VECM, there is no significant relationship between TB and Real Exchange Rate in the short run. GIRF results confirm that there is no J curve effect between Sri Lanka and India.

A small country like Sri Lanka cannot respond to fluctuation of foreign exchange rate in the short run and Sri Lanka is experiencing BOP deficit since many decades. Therefore, currency depreciation is the best policy in the long run. In the short run, Sri Lanka should take policies not related to the Exchange Rate, impose tariffs on imported goods which can be produced domestically, promote export diversification and maintain a strong relationship with big markets like Asia and Europe.

PROBABLE FACTORS FOR CREATING RAW MATERIAL WASTE: A CASE STUDY BASED ON THE SRI LANKAN APPAREL INDUSTRY

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The Sri Lankan apparel industry has become vibrant in the economy of the country at present. As the Sri Lanka's largest export industry, the apparel manufacturers have reserved a prominent position in producing high quality and low cost products while serving the international market. Thus researching existing issues in this industry provides imperative benefits to the apparel manufacturers while minimizing the losses on its investments. One such major issue is creating raw material waste at a significant level in manufacturing apparels. This has caused loss of money and unnecessary amount of landfills. Therefore, this study was done as a case study to identify the factors that create raw material waste in the Sri Lankan apparel industry. Fabric was considered as the main raw material in this study based on the evidence found in the selected apparel manufacturing company. The sample was selected as 85 apparel schedules using simple random sampling technique and both primary and secondary data were used. Primary data were collected through author observations on actual yield per yardage values and interviews on reasons for yield per yardage saving. The data were then quantitatively analyzed with suitably developed hypotheses. The data were statistically proved to be normally distributed. The descriptive analysis identified the raw material waste to be two types. They are normal waste and reserve waste. Both of these types were created by excess ordering, excess receipt and yield per yardage saving. Further, descriptive statistics suggested that yield per yardage saving was creating a significant amount of raw material waste and this factor was contributed by the pattern changes and marker improvement which were very often in the design stage of apparel manufacturing. Also the regression analysis proved that both excess ordered raw material quantity and yield per yardage saving were the main factors that created raw material waste in the Sri Lankan apparel industry. Since the raw material waste is identified as one of seven wastes in lean manufacturing, this study suggested implementing lean culture in the Sri Lankan apparel industry as an alternative solution to minimize raw material waste.

**IMPACT OF CORPORATE GOVERNANCE PRACTICES ON CAPITAL
STRUCTURE DECISIONS: WITH SPECIAL REFERENCE TO
MANUFACTURING COMPANIES IN AN EMERGING MARKET**

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Unlike in mature markets, scant attention has been given to investigate the relationship between corporate governance and capital structure in emerging markets such as Sri Lanka. Following quantitative approach and gathering data for a period of 5 years between 2008 and 2012 for 30 manufacturing companies listed on the Colombo Stock Exchange this study aims to fill this gap. Hypotheses have been developed, using the notions of agency, stewardship and stakeholder theories, to investigate the influence of corporate governance variables, namely number of meeting held during the year, board independence, managerial and institutional ownerships, on capital structure decisions measured in total debt-to-equity ratio. The study reveals that while 37.4 % of assets of the Sri Lankan listed manufacturing companies are financed by debt there is an 18.4 % correlation between total corporate governance variables and total debt-to-equity ratio. The study finds evidence to accept all the hypotheses at 5 per cent significance level. The study has both theoretical and practical implications. The findings of this study generalize the views proposed by the theories employed in the study, and also provide empirical evidence on the extent to which the corporate governance variables influence on capital structure decisions in the manufacturing companies in an emerging market of Sri Lanka.

Not Presented

THE IMPACT OF LEVERAGE ON PERFORMANCE OF BANKS IN SRI LANKA

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Leverage is one of the superlative methods that companies use as a financing method to increase their capital irrespective of the industry they are operated in. It is also a key fact which will affect a firm's performance in multiple ways. Thus, the attempt of this study is to identify the significance of leverage on bank's performance in Sri Lankan context. The key objective of this research is to identify the individual significant impact of debt to equity ratio over the firm's performance measures, earnings per share and net assets per share.

Data for the analysis was collected from Sri Lankan banks listed in Colombo stock exchange for eight years from 2005 to 2013. Since only thirteen banks were listed in Colombo stock exchange at the time of the study was conducted, all thirteen banks were incorporated for the study in order to improve the accuracy and reliability of the research. Econometric technique of regression model was used to analyze the data and SPSS software was used. Correlation analysis, regression analysis, descriptive statistics etc., were used to identify and further explain the relationship between debt to equity ratio over earnings per share and net assets per share.

Findings disclosed that, leverage shocks (debt to equity ratio) has a positive moderate relationship with both performance measures used for the study, earnings per share and net assets per share of banks in Sri Lanka. Both Regression analysis and coefficient revealed the positive, moderate and significant relationship exists between debt to equity ratio with earnings per share and net assets per share.

Not Presented

FACTORS INFLUENCING CONSUMER BUYING BEHAVIOUR: WITH SPECIAL REFERENCE TO SRI LANKAN ORGANIC FOOD INDUSTRY

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Continuous increase in the global market price for chemical fertilizers and the reduction in the output yield as a result of application of fertilizers for a considerable period have made organic farming more attractive today. Organic products can be recognized as products that come from organic farming and other organic processes. The major types of organic products can be classified as vegetables, fruits, dairy products and poultry products. This research is primarily focused on organic mushroom and mushroom related products. On one hand, there exists a potential market, which finds organic products as more nutritious and better in taste when compared with traditional food. On the other hand, majority perceive conventional vegetables and other inorganic food make no harm to human health. In the light of this, the research was conducted with the prime objective of identifying the factors that influence consumer buying behavior on organic vegetables. Sub objectives are to identify the current situation of Sri Lankan organic food industry and determine its market potential. A descriptive research under survey research technique was carried out with the intention of determining the factors which influence consumers to buy organic products. Data were gathered employing interview technique from a sample selected on the basis of non random judgmental sampling technique. According to the descriptive statistic results generated based on the responses of consumers, they have identified organic products as the products made with the use of organic raw materials which carry no harm to the environment. But their main concern was that there is no direct method to differentiate between organic and inorganic products. Further, they emphasized the less awareness among nation, myth that organic products are not 100% organic, quality issues (no proper certification) - specially for mushroom, unwillingness to pay high price and affordability issues, poor targeting and positioning, less promotions, less availability, the opinion that conventional vegetables consumed so far has no significant negative impact on health despite the awareness created by the media, use of animal refuse in organic agriculture and reliability/ recognition concern as prime factors which negatively affect their purchase intention. Further, farmers, experts and dealers also pointed out the importance of above mentioned factors in creating buying intention. Based on the findings it is recommended to establish a reputed body in Sri Lanka to issue quality certification for organic products that may help low wage earners, to enter a good market and increase income by producing and selling quality products (A national approach). In addition at micro level, better marketing strategies need to be formulated from farmers and dealers incorporating factors such as: making more outlets available, increase customer awareness, improve product quality and certification, price reduction in end product as well as cost of production. As a result of those, the cost advantage can pass down to buyer. In conclusion, we can say that the consumers, farmers and dealers are aware about what organic products are but customers are less aware about products availability in Sri Lankan market. According to customer responses and views of experts, farmers and dealers the most important factors that influence purchasing of organic vegetables basically can be categorised as positive factors and negative factors as follows. Positive factors are health concern and environmental concern, while the negative factors are high price, poor certification, poor packaging, less awareness, less availability and poor quality.

GROWTH AND PROFITABILITY OF MANUFACTURING FIRMS: A STUDY OF LISTED COMPANIES IN SRI LANKA

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Organizations have different mission and objectives which predominantly can be observed in their strategies. Some of the major aims are size, growth and profitability. There is a long debate that which factor either size or growth becomes the major source of increase in profitability. Study to identify the Cause-effect Relationship between Growth and Profitability conducted for twenty listed manufacturing companies in Colombo Stock Exchange of Sri Lanka, for five years of time period, 2009 to 2014.

Secondary data were used for the study and data were collected from annual reports as Quantitative methods approach. Using of quantitative data the task of the test of research hypotheses done through the E-views Statistical Package. The method of Descriptive statistics with Pearson Coefficient of Co-relation and Lag Regression were incorporated to analyze the data. Researcher has constructed Panel Regression model to study the effect of exploratory variables

Independent variable of Growth measured by Sales Growth Rate (SGR) and Asset Growth Rate (AGR) while dependent variable of Profitability measured by Net Profit Ratio (NPR) and Return on Assets (ROA). Research objectives of the study are, to empirically test the relationship between firm's growth and profitability, as measured by ROA and NPR, to find out the effect of Sales growth on ROA and NPR, and to examine the effect of AGR on the ROA and NPR.

Findings reveals that both Lag models of Pooled Regression and Random Effect model show that Sales Growth has not any significant relationship on NPR and ROA. Yet, Assets Growth has positive significant relationship on NPR and ROA, therefore, other Growth measurement of AGR show Positive significant relationship on Profitability as measured by NPR and ROA. Therefore, research concludes that independent variable of Firms' Growth is positively impact on the dependent variable of firms' Profitability when the firms' Growth measured by the Assets Growth.

Not Presented

**THE EFFECTIVENESS OF
INTERNATIONAL COMPUTER DRIVING LICENCE (ICDL) TRAINING
PROVIDED TO SECONDARY SCHOOL TEACHERS:
A STUDY BASED ON SECONDARY SCHOOLS IN BADULLA DISTRICT**

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The impact of Information and Communication (ICT) on the present day world has been so tremendous that it has entered the stream of education revolutionizing every branch and stream of education to such an extent that no educational system can avoid being effected positively by ICT. Therefore, it has become mandatory that the teaching community acquire expertise in the computer to ensure that they cope effectively with the future demands of the knowledge society with respect to the class room set up. Thus, The Ministry of Education of Sri Lanka urges all teachers to receive International Computer Driving License (ICDL) training. The ICDL training aims to improve teachers' ICT proficiency at three levels: ICT skills, pedagogical skills, and curriculum training.

It is indicated that some investigation be carried out for evaluating the effectiveness of ICDL training course provided to teachers. Therefore, this study investigated effectiveness of ICDL training in improving ICT competencies, whether the ICDL training influence the attitudes of teachers towards incorporating ICT into classroom teaching methods or not and its relevance for the classroom activities.

Mixed methods were selected as the research design. Purposive sampling has been used to select the teacher sample for this study. A sample of 85 teachers was selected from Badulla district. A questionnaire with attitude scales, interviews and observation were the data collecting methods, and data were analyzed using both quantitative and qualitative methods, to achieve the objectives of the study. Quantitative techniques such as percentages, tables and charts were used to analyze data.

The study revealed that even though ICDL training was effective for improving ICT competencies among 58% of participants, a high number of participants (84%) still needed more knowledge and practice on computer technology to use computers effectively in the teaching learning process as ICDL training had not provided adequate time for them to learn to use computers effectively for personal and instructional purposes. While 91% of participants stated that they were competent in skills related to Power Point presentation only 39% participants stated that they were competent in skills related to Database. Majority of participants stated that they had more confidence at Word, Excel, Power Point and Information Communication. This study recommended that the duration for ICDL training should be expanded and trainers should teach all the modules giving the same weightage especially for the trainers to concentrate more on very complex modules such as Database and Spreadsheet rather than only on teaching the Presentation module. Trainers should facilitate practical sessions by giving greater concentration on advance skills in every software application rather than concentrate only on basic skills.

**CAN THE ESL TEXTBOOKS SCAFFOLD COMPREHENSION OF
SCIENCE TEXTBOOKS?
A STUDY INTO THE POENTIAL OF REVISED SECOND LANGUAGE
ENGLISH TEXTBOOKS FOR GRADE SIX FACILITATING LEARNING OF
SCIENCE IN BILINGUAL EDUCATION**

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It is almost fourteen years since Bilingual Education has been reintroduced to the Sri Lankan national curriculum. One of the objectives of this introduction is to improve the English language competency of the students. At the inception only a limited number of schools were involved in this programme. By the year 2015 only 17.5% of the schools in the country has commenced bilingual education. In a preliminary survey, it was found that poor English proficiency of monolingual learners has been one of the distractive factors for the learners in joining the Bilingual Education programme. The role of second language teacher is crucial in developing the second language competencies of the learner in supporting Bilingual learners. In most countries where bilingual education is implemented, Content and Language Integrated Learning (CLIL) helps the bilingual learners. According to the theoretical basis of CLIL, learners need to develop both Basic Interpersonal Skills (BICS) as well as Cognitive Academic Language Skills (CALPS) in developing bilingualism and bi literacy. The English as a Second Language Curriculum has a strong role in facilitating BICS and CALPS of the bilingual learner. This paper examines how the textbooks, which are one component of the curriculum, can scaffold the development of the bilingual learners' second language competency thereby facilitating the learning teaching process in Science. Through text analysis, the language demands of the revised grade six science textbook were analyzed. These language demands were compared to the language skills expected to be taught through the revised grade six ESL textbook. It was found that ESL textbook mostly focuses on developing lower order language skills in the learner while learning science in grade six demands higher order language skills. The content of the ESL text grade 6 lacks content enriching the scientific vocabulary of the bilingual learner. The ESL text recurrently uses basic syntax while the science text contains complex sentence patterns making retrieving and reflecting on the content challenging for the learner. However, there are some instances where the content of the ESL text can be exploited by the second language teacher in the second language class developing both lower order and higher order language skills of the content learner.

LESSON PLANNING SKILLS OF PROSPECTIVE TEACHERS

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Prospective teacher trainees acquired skills of mathematical lesson planning through their curriculum during the first two years of National college of Education. The purpose of this study was to examine the skills of lesson planning, which has been learned during the two years institutional training period and how their skills implemented in internship period.

The sample consisted of 280 Sinhala medium prospective teachers, from all the Colleges of Education which conducted mathematics and science courses. Twenty four prospectors out of the above number were selected for lesson observation under Gerges (2001) sampling method. Informal interviews for the selected sample were conducted. participant observation were used as the method of data collection and transcripts were prepared using field notes and audio records. Data were analyzed using grounded theory.

It was able to identify five core categories, engagement approaches, meaningful learning opportunities, classroom and time management, assessment techniques and teaching methods. In depth of analysis of each core-categories revealed different skills implemented by the prospective teachers. They were not aware of appropriate creative engagement approaches and develop activities for the achievement of mathematical concepts. They had planned lessons to be done under the student-centered approach, but there were no appropriate teaching method for creating meaningful learning opportunities. In addition, due to inadequacy of classroom and time management strategies of prospectors failed to complete their lessons on the time. It was revealed that assessment tools were not creative to measure the objectives of whole lesson. Data gathered showed that prospectors faced problems about lesson planning. According to the conclusions arrived from the study, some suggestions were made to reform curriculum of Mathematics to improve the skills of lesson planning.

ENSURING STUDENTS' ON TIME CLASSROOM PRESENCE AFTER THE INTERVAL

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In Sri Lankan secondary schools students are taught according to a time table consisting of eight 40 minute periods. There is an interval of 15 minutes in between the 4th and 5th period. According to my experience as a science teacher, students get late into the classroom after interval. The main objective of this study was to motivate all the students in my classroom to come on time after the interval. The *action research methodology* was used in the study. Existing situation was studied and four *interventions* were implemented. The first *intervention* was to advise the students. As the second *intervention*, the late comers were sent to the principal and complained about the continued *misbehavior*. During the third *intervention* informal discussions were carried out with the parents. The fourth *intervention* was to establish an *agreement* between the selected students and their parents to bring the lunch packets from home as it seemed to be the most prominent step for avoiding the delay. Data were collected with the use of *reflective journal* and informal discussions with the selected students and their parents. *Quantitative data* were analyzed and presented as frequencies and percentages. *Thematic analysis* method was used to analyze *qualitative data*. Despite advises and warnings during first *intervention*, the number of late comers increased from three to six. After the second *intervention*, students apologized for their *misbehavior* and promised to be in the classroom on time. In the next time, only two out of six involved were present on time. The results of the third *intervention* revealed that some students refused to bring their lunch packets from home. After the fourth *intervention* it was observed that all the students were present in the classroom on time after the interval. This occurred as a result of bringing the lunch from home and avoidance of going to the canteen to wait in the queue. It was observed that sending the late comers to the principal was effective for correcting the *misbehavior* to some extent. The expected behavior was achieved 100% after informing the parents about the situation of some selected students who were still late and establishing of *agreements* between the parents and the students. Therefore, it can be concluded that frequent communication, discussions with parents and teacher mediated establishment of *agreements* between parents and students could be used effectively to motivate on time classroom presence after the interval.

EFFECT OF ELECTRONIC DEVICES ON STUDENTS' SCIENCE LEARNING

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Technology is the today's greatest factor in changing the manner of education. Technological devices or electronic devices such as laptops, computers, televisions, iPods, and mobile phones, used have now taken the place of textbooks and libraries. Children learn science from school. However, today students live in a world where they can immediate access to information at any time. Furthermore, it is well recognized that the students need extra support for their studies because of the competitive public examination G.C.E. Ordinary Level. This study investigates the effect of electronic devices on students' science learning. Data were collected from students who were selected purposively, from four urban schools in Kandy district, who have been already used electronic devices. The sample size was limited to 100 students. The selections of schools were done in representing two government schools and two semi government schools. This study was based on mixed methods, Quantitative and Qualitative research methods to collect and analyze data. The data collected quantitatively by administering a survey questionnaire. First, the questionnaire was piloted and then administered. Quantitative data were analyzed by using Statistical Package in Social Sciences. Qualitative data analysis was done by conducting in depth interviews with 10 students. Prior to conduct interviews, interview schedule was piloted with 3 students. All the interview data were audio recorded and transcribed before analyzing. It was revealed that students had used television (94%), computer (90%), telephone (82%), radio (66%), iPod (17%), and kindle (3%) as electronic devices. Television and computer was the common electronic device most of the students had used. Students had used television (77%), computers (70%), telephone (27%), radio (7%), iPod (5%) and kindle (2%) for learning of science. Many students had used television and computer for learning of science. It was revealed that television had provided number of educational programmes in Sinhala and English medium which were useful for students' science learning. Students had expressed things which they learned using the television was in their memory for a long period of time. As reported in quantitative data analysis, it was found that 90% used computer and 70% had used it for learning of science. Students stated that using computer for learning was quite different from learning in school. Computer supported them receiving related subject matter step –by –step and this had enhanced their understanding of scientific information. Many students had used mobile phone as a communication device rather than using it for learning purposes. Students did not accept radio as a learning tool. Less number of students had used iPod and kindle for learning purposes. Students had problems in using electronic devices students understood that it is easy to learn science by using them. Many students had stated that all the students unable to buy computers and the internet facility as a problem so that students were not getting equal opportunities in learning science by using computers. Based on the results, it can be concluded that use of electronic devices enhanced students' science learning. So, that made a recommendation for school principals to allow students to use internet and television after school and during holidays if possible with a guidance of a teacher.

COMPARISON OF UNDERSTANDING LEVELS OF THE PHYSICS CONCEPTS AMONG SECONDARY LEVEL STUDENTS

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Science is a main subject in the junior secondary school curriculum and it consists of concepts of physics, chemistry and biology. Understanding of science concepts is important not only to pass exams but also for day-to-day living. Students feel it more difficult to understand physics concepts comparing with biology and chemistry. The aim of the study was to assess grade eight and grade ten students' understanding of light concepts with the use of drawing. A written test with eight questions administered among 212 grade eight students and 125 grade ten students in Kandy educational zone. Each question of the test consisted of two parts; diagram and written explanation. Data obtained from students' diagrams in each question and their explanations were qualitatively and quantitatively analyzed to understand science knowledge related to light; path of light, vision, mirror reflection, refraction, and images of plain mirror. Data were also collected with the use of a teacher questionnaire and studying curricular materials of grade eight and grade ten. Data obtained from teacher questionnaire were analyzed with the use of the SPSS statistical package. It was noted that less than 20% of grade eight students provided correct diagrams for the given questions. However, except question no. 5 based on refraction less than 42% of grade ten students were able to provide correct diagrams for the questions based on light related concepts. Both grade eight and ten students provided more than 19 different incorrect diagrams. The highest percentage of incorrect diagrams was reported in refraction in grade eight while it was mirror reflection in grade ten. It was revealed from teacher questionnaire most of the teachers used practical (42.31%) to assess science knowledge of students. Responses to teacher questionnaire revealed that 98% of teachers provide opportunities for their students to draw diagrams to assess understanding of science concepts. Spending more time to draw diagrams correctly, drawing according to a scale, were given as prominent difficulties in using diagrams to understand students' science knowledge. The study reveals that most of the grade eight and grade ten students do not possess a correct conceptual understanding of light concept and therefore students fail to provide correct drawing. Students' diagrams in science can be effectively used to explore conceptual understanding of science knowledge of secondary students.

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EDUCATION GUIDANCE AND COUNSELING THROUGH THE BUDDHIST PRACTICE OF MINDFULNESS

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Educational guidance and counseling is a branch of the overall guidance and counseling. It paves the way for resolving the issues faced with both studies and imparting knowledge to the learners. Educational issues are a controversial subject. Issues relating to attention "perception" cognition and memory are conspicuous among them. There are probable solutions to these in the field of modern education psychology. The primary objective of this research is to ascertain means and ways to solve these issues adopting practice of mindfulness that is taught in Buddhism. References to the Pali canon will be made in this regards.

Epistemology is a widely discussed aspect in Buddhism. Since the Buddhist thought is inherently a preaching process it provides not only a background for an educational process but also a specific educational process. Mindfulness has a unique position amongst the Buddhist teachings. It is also the unparalleled way to reach the zenith of Buddhism - "Nirvana".

According to the Buddhist epistemology, the knowledge establishes in a man after a complex mental process. Establishing the mindfulness in the mind can result in acquiring the concentration of the mind and consequent to this wisdom originates. This is a conspicuous fact occurring in Buddhist teachings. Mindfulness and resultant concentration of the mind paves the way for acquiring sound and solid knowledge. Furthermore, the individual characteristics have to be taken into account when establishing mindfulness in someone. It can be adopted in resolving issues that crop up in the sphere of education. For instance, mindfulness is a solution to the defects of memory

Overall, the following results can be realized and achieved through developing the practice of mindfulness;

- Elimination of the prevalent negative trends in the education
- To preclude the negative trends that could enter the education process
- Initiation of new positive trends in the education
- To improve on the prevalent positive trends in the education

IDENTIFYING TEACHING STYLES AND THEIR INDICATIVE FACTORS OF ADVANCED LEVEL SCIENCE STREAM TEACHERS IN COLOMBO DISTRICT SCHOOLS

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This study is an evaluation of the commonly followed teaching styles of teachers in Advanced Level (A/L) science classes (12-13 grades) in schools of Colombo district. Every teacher has a teaching style they prefer and are most comfortable with. Previous studies have identified that there are variations in teaching style according to gender, age, teacher education and certification, class management skills and job satisfaction. Each teaching style has very distinct characteristics. Student centered activities, involving students in decision making process, encouraging student interactions, encouraging learning from experience and practicing discipline are the most commonly identified characteristics in teaching styles. The purpose of this study was to identify different teaching styles and characteristic features of teaching styles. These findings will guide the teachers to change and improve their teaching styles in order to become a better professional.

Aim of this study was to identify the teaching styles of school teachers and their indicative factors. This study followed an analytical cross sectional study design and was conducted in 25 schools in Colombo district covering all Colombo district educational divisions. It was conducted with the participation of 176 A/L science stream teachers. Data was collected using Van Tilburg/Heimlich Teaching Beliefs Scale and Principles of Adult Learning Scale (PALS).

From the total of 176 participants 5.1% (n =9) have a student-centered teaching style and 94.8% (n=167) follow a teacher centered teaching style. There were several common factors indicative of the participants' teaching styles according to the scores of PALS. They were learner centered activities, personalizing instructions, relating to experience, assessing student needs, climate building, participation in the learning process and flexibility for personal development. The commonest indicative factor was participation in learning process and the least common one was learner centered activities. This further indicates that the learner-centered activities and student-centered methods of teaching were not common within the group.

Factor analysis was done on Van Tilburg / Heimlich Teaching Beliefs Scale and it indicated that the scale was more focused on student centered teaching styles, the responses it received indicate that in practice most teachers are more teacher centered, but some have student-centered features in their teaching. Teachers showed unwillingness to change their teaching styles to suit different learners in practice. Majority of the teachers in study sample currently follow a teacher-centered teaching style. Their teaching methods include some student centered teaching factors, but they are unwilling to change their teaching methods. This difference may occur due to the lack of resources in Sri Lankan classroom setting or due to lack of awareness the teachers have regarding student-centered teaching. The reasons for these tendencies within the population should be identified and addressed.

Identifying the different teaching styles of teachers in secondary education can help increase the self-awareness of the teachers of their teaching style and how they can change or improve their teaching style to better suit the needs of individual learners and help student learners to better adapt to adult learning in higher education.

A STUDY ON THE CHILDREN'S PARTICIPATION IN SOCIODRAMATIC PLAY IN THE PRESCHOOL CLASSROOM

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In preschool years play is the vital mode of learning of children. Among different forms of play sociodramatic play is highlighted as most common and important type of play during 3-5 years old as it is a medium for the development of the cognitive, creative, and socio-emotional abilities that will be useful within a school environment. In Socio-dramatic play children use objects as props to develop story episodes that involve other children. However, increased academic expectations for children entering preschools have shifted the focus away from teaching children through play. Thus this study focused to investigate how children participate in sociodramatic play with regard to their age, gender and themes used in a preschool classroom.

A qualitative approach was employed in the study utilizing an action research design. A sociodramatic play intervention was carried out in a preschool located in Nawala area in the Colombo district with a cohort of 10 children purposively selected ranging in age from 3 years to 5 years over 4 weeks. The data consisted of observations, field notes documented with the support of video recordings, interviews and teacher's reflective journal and analysed using descriptive analysis align with the research objectives by deriving sub themes developed based on literature.

The intervention revealed that children showed a greater interest for sociodramatic play when compared with the other usual classroom activities. A significant difference did not appear with regard to the age in the children's participation. Girls became more active in some of the subcategories in sociodramatic play intervention than boys while boys showed more participation in the rest of the subcategories. The nature of the themes had an influence on the increment of children's participation in the intervention. The opportunities for the participation of girls and boys, different age levels, opportunities for variety of themes, previous practices and skills, nature of the teacher's involvement became the significant factors for the improvement of participation in sociodramatic play.

Finally, the study concluded that the sociodramatic play is both a medium and context for developing playful experiences for the development of children and therefore the findings proposed to develop a greater emphasis and encouragement on sociodramatic play by including it into the preschool curriculum and providing guidelines for the implementations for both teachers and preschools.

THE BEST METHOD OF LEARNING NEUROANATOMY IN TERMS OF MEDICAL STUDENTS' PREFERENCE AND PERFORMANCE

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The Department of Anatomy, Faculty of Medicine, University of Peradeniya takes an immense effort in teaching neuroanatomy to undergraduates. Students are also in a continuous quest to find out which learning methods available to them are of the greatest efficacy in terms of performance at semester exams. This study investigated the learning methods to be stressed upon during the teaching and learning process of neuroanatomy based on students' preference and exam results. The main objective was to find out the most contributing method in learning neuroanatomy according to students' preference out of the methods available: dissections, pro-sections and audio-visuals/multimedia, text books, lectures and discussions, and impact of it on the results. The advantages and disadvantages of each method according to students' perception were also studied. Sample size was calculated using the standard sample size calculation equation for descriptive cross-sectional studies. Firstly, the learning methods were sorted by the students from the most to the least preferred based on what they perceived to have contributed to their semester examination performance using a questionnaire. This was taken as their order of preference. Then chi-square test was used to correlate the above four preferred methods and the order of preference. Secondly, contingency tables and chi-square analysis were used to correlate the first method of preference (considered as the most contributing method) and the graded results from the Central Nervous System Anatomy part of Y2S1 semester examination of 09/10 batch. Basic descriptive studies were used to analyze some important selected qualities of the mostly preferred method by means of a five point Likert scale. The data analysis revealed that there was a significant difference between the preference of a student and the four methods of learning neuroanatomy (p value < 0.05). Non parametric chi-square test was used to associate examination results and the method of first preference (p value was 0.689). Therefore, it suggests that the method of first preference and the exam results are independent at 95% confidence interval. Pro-sections had the highest satisfaction rate while the exact opposite was true for Dissection. Out of 120 students who passed, 50 chose Pro-sections whereas 11 chose Dissection as the 1st preference. Pro-sections and audio visuals/multimedia had been the most preferred method as the students strongly agreed that it possesses the following qualities: availability of adequate resources, less time consumption, easiness to understand and higher retention. Dissection had been the least preferred method in learning neuroanatomy because it was more time consuming than the others. The preference over a particular learning method was not due to chance. Although students perceived a particular method of learning to have contributed mostly for their examination results, there was no statistically significant association between the two. This could be due to a certain combination of learning methods which had a greater impact on results. Other factors such as time spent on the learning method, the amount of time allocated by curriculum, the availability of resources and language/new terms, might have affected the examination results. In conclusion, there was no single most contributing method for learning neuroanatomy according to the preference of pre-clinical medical students. The decision as to which method was better seemed to be more subjective. The most preferred method in learning neuroanatomy was pro-sections and audio visuals/multimedia while the least preferred method was dissections. Dissection had been widely considered to be inferior in general although there was no preferred optimal method.

SEEDING SCIENCE SUCCESS: RELATIONS OF SECONDARY SCIENCE STUDENTS' MOTIVATION WITH THEIR ASPIRATIONS AND ACHIEVEMENT

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In the contemporary world, every sphere of life has been revolutionised by science. As such, science understanding is an increasingly precious resource throughout the world. Further, as science knowledge is contestable, continuously subject to revision, refinement, and extension, the dissemination and digestion of new scientific knowledge are very important. Despite the widely recognised need for better science education, the numbers of students pursuing science continue to decline internationally and the percentage of school students studying science is particularly low. This has resulted in a lack of qualified people for employment in science-related jobs. Past research has shown that the decline in science enrolments is related to many interrelated factors, such as: students' academic abilities, teaching methods, the absence of motivation to study science, and a lack of interest in science subjects. However, there is a dearth of research investigating relations among students' science motivation, aspirations, and achievement in different domains in science. Thus, this study investigates the relations of secondary science students' motivation in different disciplines of science with their academic achievement and aspirations. This was a quantitative study and convenient sampling technique was used. The sample consisted of three hundred and ninety five students (females = 208, males = 187) from Year 7 to Year 12 (aged from 12 years to 17 years) from three schools in New South Wales, Australia. A validated questionnaire was administered in data collection and the data were analysed using SPSS and Mplus software packages. SPSS was used for descriptive statistics whereas Mplus was used for confirmatory factor analysis and structural equation modelling. The results show that science motivation and science aspirations were not domain specific. Further, students' science motivation did not vary across gender and year levels. Though students' science aspirations did not vary across gender, they became stronger with age. In general, students' science motivation was positively related to science aspirations and science achievement. Specifically, students' year level and intrinsic motivation in science were predictors of their science aspirations, and intrinsic motivation was a significant predictor of students' achievement. The findings will be useful for science educators in planning and developing science curriculum and policies with regard to students' motivation. Equally, science teachers may find implications for classroom practices for the planning and conducting of science lessons, for conveying scientific concepts and principles to students more effectively, and in considering the need to generate enthusiasm about the subject in young science students.

TEACHER Demeanor AS PERCEIVED BY GENERAL INFORMATION TECHNOLOGY (GIT) STUDENTS IN RELATION TO THEIR ACHIEVEMENT IN IT

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General Information Technology (GIT) was first introduced in 2002, based on a decision taken by the Ministry of Education to reintroduce the computer education related subject in Grade 12 (First year of GCE A/L). General Information Technology is one of the subjects being taught at that level catering the needs of basic Information and Communication Technology (ICT) knowledge and skills to fulfill the requirements at higher education level. Moreover, the subject - General Information Technology - commands the attention of all the students in Sri Lanka. The statistic shows that most of the students feel very problematic in learning General Information Technology. Hence, the General Information Technology teachers are expected to be more proficient and effective in their profession. The foremost objective of the study is to find out the level of teacher demeanor as perceived by General Information Technology students and to find out the level of achievement in Information Technology of General Information Technology students. The researchers used the survey method for this study. The sample for the study contained of 300 General Information Technology students studying in four different schools of Gampaha District, Sri Lanka.

Researches used the Teacher Demeanor Scale prepared and validated by S. Arockiasamy (2004). The tool consists of five dimensions like chalkboard work, inquiring, strengthening, clarification & illustration and session management. The findings of the study were more than 67% of General Information Technology students have recorded their neutral perception on the teacher demeanor of their respective teachers. The male and female General Information Technology students differ significantly in their perception on teacher demeanor in total and in the dimensions - questioning and session management. A significant relationship was not found between the perception of General Information Technology students on teacher demeanor in total and their achievement in Information Technology.

In conclusion, it is decided that a school can play a very significant role in the moral expansion of offsprings. The most important representative in the school is understandably the teacher. It has been strained over and over that nothing can be more effective and helpful in molding the child's moral demeanor than the own moral demeanor of the teacher.

USING MOBILE PHONES IN A LESSON WITH MORE CONFIDENCE: USE OF MOBILE PHONES ON A PRIVATE NETWORK

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The educational potential of mobile phones are reported in the recent research literature. Even though teachers recognised this potential, they tend not to use them in teaching due to the fear of students' misuse of mobile phones during learning activities which leads to disciplinary issues. The research reported in this paper explores the possibility of using mobile phones (without sim cards), which are connected to a private network, in science teaching and learning. The objectives were to investigate how mobile phones can be used for teaching in a safe way and to examine how a mobile phone in a private network supports students' science learning. The methodological approach of this research is purely qualitative. The participants were a group (18) of purposively selected secondary school science teachers from the Central Province. The selected teachers were grouped in to three and developed lesson plans. They selected three science lessons from the Sri Lankan national science curricula for grades 6 to 11 where the concept of mobile phones in a private network could effectively be used. The participants drafted their lesson plans and tested whether the mobile phones would fulfil their expectations for the planned activities. Then they developed a concrete set of instructions and the designed lessons were role-played by a member of the group. At the end of the role-play of each lesson, there was a whole group discussion. During these discussions, the pedagogical practices as well as the ways of using the mobile phones in a private network to support these practices were critically evaluated. Based on the feedback received for each lesson the lesson plans were fine-tuned. Then the lessons were implemented in real classroom settings. This paper is based on one of the lessons, 'Waves and their Applications' for grade 10 students. The data were collected using observation as audio, video and field notes. Then the data were analysed using the thematic analysis technique. According to the findings, teachers reported that the mobile phones in a private network that is connected to the teacher's computer enabled teacher to monitor students' engagement by checking how students carried out the step-by-step activities. Further, teacher valued the unique way of providing instructions to the students creating a leaner centred safe learning environment. Students highlighted the possibility of viewing the changing character of waves through the mobile phone's screen to understand the scientific concept. Moreover, they appreciated the opportunity of using one of their favourite technologies in learning science in an interesting way. Overall lesson was successful and both teacher and students admired the opportunities provided by the mobile phones in a private network that created a safer learning environment.

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AN EVALUATION OF THE EFFECTIVENESS OF OUTCOME BASED EDUCATION AND STUDENT CENTERED LEARNING IN UNDERGRADUATE EDUCATION

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It is imperative that students of the twenty first century acquire essential skills during the pursuit of education at Higher Education Institutes (HEIs) to take on the challenges of the working world. Hence, it is necessary that HEIs fashion their teaching/learning programs such that the students possess the major generic skills at the time of graduation. The University of Peradeniya, is one of the first universities in Sri Lanka to identify the need of moving out of the Teacher Centred Learning (TCL) environments and to make a paradigm shift to embrace new concepts such as Outcomes Based Education (OBE) and Student Centred Learning (SCL). The overall objectives of the research was to identify and evaluate the different OBE and SCL methods currently adopted in teaching, to evaluate the effectiveness of using OBE and SCL teaching methods in undergraduate teaching, based on an assessment of the student and teacher perceptions.

The two courses notated AB1101 and AB 4105 were from different years of study (first and final years respectively), one covering the core program with 154 students and the other offered to 21 students majoring in one department in the BS degree program. The courses were selected based on the facts that the course should consist of scheduled OBE and SCL based lessons in theory/practical /independent learning activities. Once the assigned activity was completed, two independent surveys were conducted, with students to gather information related to the effectiveness of the activity in terms of understanding the concepts and acquiring skills, and with the teachers to gather information related to their assessment strategy, expected outcomes and improvement of student attitudes. The activities were videoed and the teaching aid provided on the day (e.g.: handouts, power-point presentations) were collected for future reference.

For both the courses AB1101 and AB4105 under review here, 93% and 100% of the students agreed that the planned activities did cover the defined intended learning outcomes of the courses. Based on the teacher's perception the activity conducted for AB1101 was expected to develop intellectual (I), practical (PR), communication (C), inter-personal (IP) and professional development and self-management skills (P). According to the student standpoint the majority (I-90%, PR-95%, C-86%, IP-93% and P-72%) either agreed or strongly agreed that the planned activity did enable them to master these skills. In addition to the skills identified in AB1101, the teacher of AB 4105 identified that the activity will develop numerical (N) and information technology (IT) skills of the students. Similar to the responses of AB1101, majority of the AB4105 students either agreed or strongly agreed that the OBE and SCL based activity developed all the skills identified by the teacher (I-95%, PR-95%, C-100%, IP-90% and P-100%, N-95% and IT-100%). In both the courses, majority (AB1101-97%, AB4105-100%) of students agreed that the OBE and SCL activities were effective or very effective compared to a classical TCL approach in developing the desired skills. Thus, irrespective of student numbers and when the courses were offered both courses gave desirable results to students and teachers. Hence, integration of OBE and SCL based activities is an effective mean of disseminating knowledge, development of skills and making the learning experience interesting for the modern day undergraduates.

**THE ROLE OF FIELD LEVEL EXTENSION OFFICERS AT DIVI
NEGUMA RURAL DEVELOPMENT PROGRAM:
A STUDY IN RATHNAPURA DISTRICT**

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Poverty is widespread in the rural areas of Sri Lanka. Hence, it is crucial to enhance agricultural productivity, income diversification and economic growth in rural areas. Considering the needs, the Government of Sri Lanka (GOSL) has implemented range of measures to eliminate poverty through empowering livelihood improvement projects such as "*Divi Neguma*" (Livelihood upliftment) program, targeting on rural development, alleviation of poverty and malnutrition, and empowerment of rural livelihoods. Thus, the intermediaries who link the government and the participants are the field level extension officers. But they have been severely criticized by the participants. So this study was done to examine the roles of the field level extension officers and perceptions of the participants on the knowledge, skills and the personal qualities of the extension officers. A survey study was carried in Elapatha D/S division with a sample size of 150 participants. Participants perceived that the extension officers were influential in the startup motives of the participants in to the programs but the follow up roles, which are the most important roles for the success of the *Divi Neguma* program, were not fulfilled by the officers. The participants also perceived that the field level extension officers were not well prepared when communicating with the participants and always neglected the importance of feedback in the communication process and they were not fully committed to the activities related to the *Divi Neguma* program. This study reveals that the policy makers should constantly review the performance of the extension officers and assess their training requirements.

FACTORS AFFECTING THE SELECTION OF AGRICULTURE AS A SUBJECT AMONG THE GCE ADVANCE LEVEL STUDENTS IN SRI LANKA

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Agriculture has been included as a major subject of choice in GCE Advance Level in Sri Lanka. In the recent past it has been identified that a lower percentage of students select agriculture as a subject in GCE (A/L). Students who follow biology stream are selected to Agricultural degree programs. Some students do not select agriculture for their first attempt of GCE (A/L) but later transfer from biology to agriculture in their second and third attempts. This research was conducted in Galle Municipal council area to identify the factors affecting for selection of Agriculture as a subject in GCE (A/L) Students. Research approach was deductive approach and descriptive in nature. Survey strategy was used as the research strategy. Seven schools were selected by using stratified random sampling from thirty schools which offer advanced level classes in Galle Municipal council area. There were two samples considered in the research; *viz.*, Students who have selected agriculture and students who have not selected agriculture. Among the total sample of 405 students, 254 students do not follow agriculture and 151 were following agriculture as a discipline. Data were collected through pre tested interviewer administered questionnaires. Data analysis was done by SPSS 16 and Microsoft excel software packages. Descriptive analysis and non-parametric analysis (chi-square) were performed to analyze the data. Factor analysis was used to reduce the factors affecting for reluctance of students in selecting agriculture as a subject.

The internal factors for not selecting agriculture as an advanced level subject were due to agriculture course content, status for the subject in the society and barrier for higher education as perceived by the students. Most students did not prefer the practicals related with livestock and the less updated syllabus. Perception about the subject among the society is also very low. For Agriculture, Z-score value is low compared to physics. A student who gets a credit pass (C) in agriculture might not be selected to the university whereas a student with the same grade for physics might get university entrance. Family influence, less opportunity to learn agriculture and friends' influence were considered as external factors. Parents and siblings were the major cohort influencing the selection. Tuition facilities were very much limited to metropolitan areas and few teachers were available to teach the subject. Students select agriculture as an advance level subject due to social, economic, personal, family, school and living area suitability. Students improve their attitudes and entrepreneurial ability and self-employment skills, and improve them by following this subject. Agriculture discipline provides more job opportunities contribute to the national economy and compared to urban students, students from rural and semi urban areas tend to select agriculture as a subject. There is no relationship between age, gender, nationality, time of facing for examination and living area and selecting or not selecting agriculture for advance level examination. When selecting subjects for GCC (A/L) many factors affect the decision, not a single factor.

EFFECTIVENESS OF THE UNIT PLAN IN TEACHING-LEARNING PROCESS

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A research based on preparing a unit plan for the “Plant Diversity” in grade 6 science was conducted at K/Ankumbura Parakrama Central College for a period of three months. According to the teachers instructional manual the particular unit needs to be covered in 9 lessons of forty minutes period. Students learn basic morphological diversity. Learning science as a separate subject is a new experience for sixth graders. Though students learn some aspects of plants in primary grades, this unit can be given a learning experience which is strong enough to internalize the key concepts accurately.

To accomplish that target, a unit plan was done for the unit “Plant Diversity” after studying the given questionnaires, pre-test results, ERA curriculum of the primary education and secondary curriculum. Based in the pre-test results, experimental (UPG) and control (TIM) groups were elected. Lesson for the experimental group were conducted by the researcher according to the unit plan. The control (TIM) group was taught by their subject teacher following the grade 6 science – Teacher Instructional Manual. At the end of the teaching-learning process a post-test was administered to both groups.

At the post-test the experimental group performed well and the mean mark of the experimental group was higher than the mean mark of the control group. Further, the findings of the study indicated that planning lessons by the teacher him/herself facilitate teaching-learning process. Students should be given the opportunity to study plants in the natural environment for better understanding. Use of live specimens in the class-room enhances learning and inculcate towards the nature. Further, students are able to get the concepts in science precisely when appropriate interventions are made.

A STUDY ON INFORMATION SOURCES OF PADDY FARMERS

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In agriculture, the role of information cannot be over emphasized in enhancing the agricultural development. Information is crucial for increasing agricultural production and improving marketing and distribution strategies. Information sources play a major role in increasing the productivity in paddy farming too. Socio-economic factors of farmers influence their usage of information sources. New sources like mobile phones can be introduced with the development of communication technology. This study focus to investigate the available information sources, their suitability, reliability, relationship between farmers socio-economic factors and information source usage and potential of mobile phone usage as a source of information. This study was conducted to find out the information sources used by paddy farmers in the Wellawa Agrarian Division. About 150 farmers were taken as the sample using simple random sampling technique. Data were collected through face to face interview guided by a structured questionnaire. The research included a mixed method as both quantitative as well as qualitative information were needed. Qualitative data were used to interpret the quantitative data. Data analysis was done using descriptive statistics and bivariate correlation analysis.

According to the findings, farmers frequently use farmer organizations, government extension officers and fellow farmers as prime information sources. Delayed responses and the lack of interest towards the information sources are the serious problems associated with information sources. Most reliable sources for information are farmer organizations, government extension officers, fellow farmers and television. The results of the bivariate correlation analysis showed that there is weak positive relationship between information source usage and educational level of the farmers ($\rho=0.253$, $p=0.002$). There is weak negative significant relationship between information sources usage and experience in farming ($\rho=-0.285$, $p=0.000$). Farmers mostly receive information about insects and pests, diseases and fertilizer usage. Farmers receive information about transportation, marketing and market prices at the least. Majority of farmers use mobile phones and willing to use mobile phone as an information source. This study recommend to authorized institutions to launch awareness programs to attract farmers towards the information sources, convey their messages through reliable sources, attract younger generation towards the farming, do trial programs to check the mobile phone suitability as an information source and arrange telecasting time of television programs regarding paddy farming.

DISTRIBUTION OF LEARNING MODALITIES AMONG UNDERGRADUATE MEDICAL STUDENTS

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Learning modalities are developed in relation to sensory pathways through which individuals give, receive, and store information. These include visual (V), aural (A), and tactile/kinesthetic (K) modalities. Although learners use all these sensory modes in learning and understanding, one mode is often being dominant to others and preferred by the learner. Researchers have used questionnaires to assess VAK modalities. A further improvement of this included reading/writing (R) as mode of learning and expanded the questionnaire to assess VARK modalities. Identifying these learning styles and its influence on performance would help the learner and the teacher to improve the learning process and make teaching and learning more meaningful. Therefore, the objective of the present study is to describe the learning styles of medical undergraduates and to assess its association with their performance in human anatomy.

This is a descriptive cross sectional study conducted among third year medical undergraduates who have completed the 2nd year recently. The VARK Questionnaire (Version 7.2) was used to assess the learning styles among them. Performance was assessed by using the aggregate of marks obtained for human anatomy at the end of 2nd year. Distribution of learning styles was assessed for all students and compared it with that of the highest performers and lowest performers.

Of the 172 students 42.5% were unimodal learners. Of the multimodal learners 26.7% used all four modalities. Visual learners were the least among unimodal learners and kinesthetics were the most in this group. In comparison, the highest performers (n=20) were distributed equally between unimodal (50%) and multimodal (50%) styles. Nevertheless, of the lowest performers (n=10) majority (80%) were in the multimodal group belonging to the category using A and K modes (bimodal) predominantly (40%). In comparison only 5% of the higher performers were in this category whereas majority of the multimodal performers were using all four modes equally. Distribution of learning modalities in the present series showed a similar pattern to that of other studies done among medical and premedical undergraduates elsewhere. Understanding these trends provided an insight to an aspect of this neuro-cognitive behavior that helps the learner and the teacher to adapt their learning and teaching styles accordingly. However, further studies are needed to understand the other factors that influence learning, understanding and performance.

TEACHING SECOND NATIONAL LANGUAGE (TAMIL) IN JUNIOR SECONDARY GRADES: EFFECTIVENESS OF CLASSROOM PRACTICES

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Teaching Second National Language (2NL) in Secondary school is one of the initiatives of the Government to bridge the gap between the ethnic groups. Social cohesion is one of the objectives of education and it was clearly stated by the National Education Commission in its first report (NEC, 1991). 2NL was introduced as a compulsory subject in junior secondary grades in 1997. Two periods were allocated for teaching 2NL. Teachers also specially trained to teach the second language. 2NL teaching should be attractive and interesting to non-native students. Even after seventeen years of implementation of this policy still the teaching of 2NL has not been fully effective. Second Language teachers must use effective methodologies and modern technologies. Objectives of the study are to identify the strengths and weaknesses of current practices of learning and teaching 2NL, to examine the factors that are hindering effective classroom practices in learning and teaching of 2NL and to propose recommendation to improve 2NL learning teaching practices in classrooms

This study was conducted based on two educational zones in the western province, Sri Lanka with a sample of 100 students, 16 principals and 75 teachers from 16 schools from this province. Quantitative and qualitative data were gathered using, focus group interview and observation of teaching-learning process in few classrooms.

Vast differences in using strategies by native and non-native teachers were noted and both categories of teachers were influenced by traditional methods of teaching. They were not keen to develop communicative process of 2NL learners. Low academic and professional qualifications of non-native teachers was a huge barrier in achieving the expected outcomes in 2NL learning and teaching, class room activities based on textbooks were not adequate and innovative in view of arousing the interest of non-native learners, learning environment created in classroom were not attractive and not motivating, textbooks and other supplementary reading materials were not effectively used by teachers and those materials were discouraging students from effective utilization. Majority of non-native teachers were involved in teaching without sound knowledge of 2NL (Tamil), assessment procedures adopted by teachers were also not effective and transparent. 80% of 2NL (Tamil) teachers were found without notes of lessons or preparation and properly organized teaching aids.

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EFFECT OF ENVIRONMENTAL EDUCATION ON UNDERGRADUATES' ATTITUDES TOWARDS ENVIRONMENTAL FRIENDLY PLANTING DESIGNS

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Environmental education is an important part of a curriculum which can be used to improve the overall behavior of future citizens toward the environment. It improves students' attitude, knowledge and awareness on the environment while helping individuals to acquire a set of values and feelings of concern for the environment and the motivation to appreciate and protect the environment. The role of wild plants in environmental conservation is highlighted in Landscape Horticulture curriculum offered by the Department of Horticulture and Landscape Gardening for third year specialization undergraduates at the Wayamba University of Sri Lanka.

Therefore, this study was conducted to evaluate the attitudinal change of undergraduates before and after exposing to Landscape Horticulture module. Three plots (3 m x 3 m) were established with only wild plants, wild plants enriched with an ornamental plant (*Zinnia elegance*) and only ornamental plant (*Zinnia elegance*). A pre-tested questionnaire was used to assess a group of undergraduates' response to three planting designs in three different time periods *viz.* prior to lectures, 2 weeks and 8 weeks after exposure to the Landscape Horticulture lectures respectively. Data were subjected to nonparametric Kruskal Wallis test and analyzed using Minitab version 16.

A significant ($p < 0.05$) change in the undergraduates' attitudes towards the three planting designs was observed among the three different time periods. Prior to exposure to the lectures, the least median rank (1) was recorded for the plot with only wild plants while other two plots obtained the median ranks of 2 and 3, respectively. After being exposed to two weeks of lectures, the highest median rank (3) was recorded for the plot planted with wild plants enriched with *Zinnia elegance* and the plot with only *Zinnia elegance* recorded a median rank of 2 followed by the plot with only wild plants. After being exposed to lectures for 8 weeks, the undergraduates' preference for the plot with wild plants enriched with *Zinnia elegance* still recorded the highest rank (3). However, other two plots recorded similar ranks (2). The value of both biodiversity conservation and aesthetics is high in plots with wild plants enriched with *Zinnia elegance*. The concept of incorporating wild plants in designing and its benefits are inculcated in the course module. Therefore, this study proved that exposing undergraduates in the classroom to environment related modules could lead to the attitudinal changes towards the environment. Hence, universities and schools should pay a considerable attention to environmental education and thereby educating future leaders and enriching their attitudes toward resources, the environment and quality of life. This would prove to be extremely important and beneficial for the future generations to come.

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USAGE PATTERNS OF THE LEARNING MANAGEMENT SYSTEM IN THE SEMESTER BASED UNDERGRADUATE TEACHING

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The e-learning concept refers to the learning through technology but the Virtual Learning Environment (VLE) specifically represents the use of Information and Communication Technology (ICT) for teaching. An Information System (IS) which can setup a VLE is identified as a Learning Management System (LMS). Teacher's continuous commitment with LMS and organizational requirements will motivate the students to access the system. LMS log analysis is an effective method for analysing usage behaviour to reveal the actual site access pattern of users. Such patterns reveal the real situation of the system adoption and usage. University of Peradeniya (UOP) embraced the e-learning concept by setting up faculty VLEs successfully using Moodle, an open source LMS. Teachers' site access log records (1,075,000) in a semester of one faculty LMS in UOP were extracted from the Moodle database to evaluate the teachers' e-learning usage behaviour. Log records were pre-processed (66,613) using SQL queries and then downloaded to Microsoft Excel to apply quantitative data analysis techniques for evaluation. The results show that 65 teachers (62%) from the faculty teaching staff (105) acceded to use the site for teaching. The number of teacher access mean value of a week is 45 with a standard deviation of 14.17. Figure 1 shows the number of site logins made by teachers during 17 weeks. It shows less than 10 teachers had a significant continuous commitment with the system throughout the semester while the majority have only accessed the system less than 5 times per week.

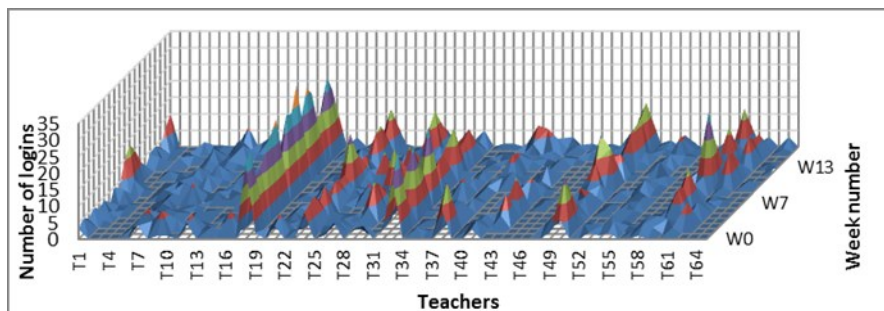


Figure 1. Teachers' e-learning site logins in a semester

Log data further revealed that the teachers have used the LMS mainly for file sharing (88%) and communication (88%) but very few have touched assessment tool (8%) and collaborative teaching tools (3%). None of the teachers have developed self-learning materials. System complexity, inadequate time and facilities, technology incompetence and personal attitude are possible reasons for not acquiring the maximum adoption rate of the e-learning system. Training, organizational support, peer discussions, use of the alternative tools to lower the system complexity and continuous support will be able to promote the teachers to blend the e-learning technology for their teaching. However, further investigation is needed to reveal intrinsic personal factors that deprive the teachers using the e-learning site effectively.

TEACHERS' PERCEPTION ON CHEMISTRY PRACTICAL WORK IN GRADES 10 AND 11

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Laboratory activities help students to develop their conceptual understandings, scientific processing skills, problem solving skills, application skills and techniques, interrelations among variables and analyzing skills for chemical analysis and synthesis. Since Chemistry is an experimental subject this study aims to reveal science teachers' perceptions on chemistry practical work in grades 10 and 11. In this study, twenty (20) science teachers from the secondary schools in Northern Province were selected under the purposive sampling techniques and given a questionnaire which was piloted and improved. The questionnaire consists of thirty six questions. Teachers responded to all the questions in the questionnaire directly. Teachers' perceptions on chemistry practical work were analyzed in terms of several variables such as gender, experience, qualifications, and practical implementation methods, and making students' interest in practical work, to find whether there are any significant relationships between them. The findings revealed that practical implementation methods and the gender are significantly uncorrelated with the teachers' perceptions on use of practical work in chemistry teaching. Although education qualification didn't affect on making students' interest in practical work, the professional qualifications and experience affect on it. According to the responses of open ended questions the teachers preferred to do the practical work as student-centered teaching, but they do demonstrations of chemistry practical due to the time management problem etc. Although most of the teachers were interested in doing practical work in chemistry, they felt that this is an additional work load.

PERSPECTIVES OF UNDERGRADUATES ON LIBRARY USE: A CASE OF UNDERGRADUATES OF AGRICULTURAL SCIENCES

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Libraries have always played significant role in teaching, learning, and research processes. However, due to busy time schedules and with many other reasons, it has been found that not all students consider the library as critical to their studies, especially at the undergraduate level. A number of studies have been conducted to reveal the library usage and services among undergraduates. To provide quality services, the library should have a periodic assessment to maintain and to improve the quality to meet the user demand. Assessment of the awareness of a library can be done by getting feedback from users. It helps to identify the performance of the services provided for the library users.

A research was conducted among the undergraduates of the Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka. Survey methodology was used and self-administered questionnaire was used as the research instrument which consisted of structured questions. Most of the closed ended questions were designed to elicit responses on a three-point Lickert scale. The sample frame of the study consisted of 291 undergraduate students in the Faculty of Agricultural Sciences and sample of 167 students were selected proportionately by using simple random sampling technique which consisted of all four batches. The questionnaires were pre-tested and distributed among the students. Collected data were analyzed by using frequency percentages and descriptive analysis.

The overall findings of this study suggest that undergraduates of Faculty of Agricultural Sciences have well awareness about library services and resources. They spent nearly two hours per week at the library. According to the results obtained, 49% of the undergraduates visit library twice a week. Almost all students know the main services offered by the library except periodicals, paper cutting services, CD collection and Online Public Access Catalog (OPAC). Undergraduates visit library mainly to use the lending service. 34% of the sample visited library to read paper cuttings. They generally use reference books, newspapers, subject books and general books. According to the results, they mainly focus on referring subject related material. Majority (67%) of the sample uses library catalogs and 52% of the sample tends to locate the materials by their own. Limited time to study books was the major barrier to visit library. Due to availability of internet facilities they tend to refer e-books and e- resources than referring books and utilizing other library services. Undergraduates suggested to increasing the number of copies of subject related reference books, improving the E-Learning services, and improving the lighting and seating facilities of the reading area in order to improve the quality of library service of the faculty.

Study findings emphasize that the overall awareness level of the services offered by the faculty library is very good but awareness program should be conducted to promote awareness and use of electronic information resources such as online periodicals. Library should focus to introduce newly published books, online services, and the lighting as well as the seating facilities in order to improve the quality of the library service. It will contribute a lot to uplift the quality of undergraduates of the Faculty of Agricultural Sciences.

EXPLORATION OF FACTORS AFFECTING FOR POOR PERFORMANCE IN SCIENCE SUBJECT IN THE GCE (O/L) IN THE ISLAND ZONE OF JAFFNA DISTRICT

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Students in the Island zone of Jaffna district in Sri Lanka perform poorly on science subject in General Certificate of Education (Ordinary Level) [GCE (O/L)] examination compared to students in other educational zones. This prevailing situation could be due to many interrelated factors. However, there is a dearth of research on this aspect in remedying the situation. Thus, this study aimed at investigating the factors affecting the poor science performance of students in the Island zone of Jaffna district in GCE (O/L) examination. The findings of this study will help in remedying the issue to meet the national goals of the education in Sri Lanka. This is a quantitative study. Thus, quantitative approaches were used in the data collection process. The simple random sampling technique was used in selecting the sample for the study. The sample consisted of 250 GCE (O/L) students, 25 science teachers, and 20 school principals from twenty schools in the Island zone. Students sample included the students who sat the GCE (O/L) examination before 2015. Documents on students' achievement and survey questionnaires for five years were used in the data collection process. Survey instrument was administered in the data collection process with minimal disturbance to selected schools. The GCE (O/L) Examination results were used as reference points and indicators of students' science performances in the schools of the island zone. The data analysis was conducted through the Statistical Package for Social Sciences Version 7 (SPSS) and MS Office Excel 2010. Data were analysed for descriptive statistics and regressions. The results reveal that teacher commitments, teacher travelling distance, the usage of laboratories, completing syllabus on time, support given by others, usages of learning materials, travelling distance of students to schools, and learning hours at home relate with the students' science achievement at GCE (O/L) examination. Hence, these issues should be addressed and the classroom practices to be re-evaluated with the aim of improving science teaching-learning process to achieve higher students' performance in Island zone to meet the expected national educational goals in Sri Lanka.

**FACTORS AFFECTING THE SELECTION OF THE ADVANCED
LEVEL SCIENCE STREAM:
A STUDY OF STUDENTS IN NUWARA-ELIYA ZONE**

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Although the number of GCE. Advanced Level students who offer science subjects in Sri Lanka is below the goal of education authorities, very little research has been performed on factors which affect students in selecting an Advanced Level study stream. The purpose of this study is to research factors influencing students in the Nuwara-Eliya educational zone, in choosing (or avoiding) science subjects. Here, effects of gender, socio-economic factors as well as perceptions of students were studied. A mixed method utilizing questionnaires and semi- structured interviews was used for 185 students in grade 12, from six schools in Nuwara-Eliya educational zone. The survey questionnaire consisted of open and close ended questions, and queried respondents about gender, monthly domestic income, reasons for the study, teacher attitudes towards their selection, resource availability, etc. In close-ended questions, students had the freedom to choose and prioritize multiple factors.

One hundred and fifteen students from the above sample were from the GCE Advanced Level arts and commerce subject streams, and seventy were from the GCE Advanced Level science and mathematics streams. Furthermore, semi-structured interviews and questionnaires were given to 55 teachers from the same schools. Basic statistical procedures and qualitative data analysis techniques were used to interpret data. Results indicate a large majority (87%) of students choose their study stream according to their own preference. A very minor portion of students identify their parent's wishes (5%) or their friends (8%) as the major influence in choosing a subject stream. Responses in semi-structured interviews indicate that in some cases students are avoid the science stream due to a perceived lack of future opportunities, both in higher studies and employment. Further research needs to be conducted to probe the unperceived social influences which affect students in their dislike of science subject. Quantitative data showed that there is a correlation between the monthly domestic income and the likelihood of a student choosing science; students were more likely to choose science when their family's income was relatively high. Furthermore, in the sampled student population, female students were more inclined to choose science and arts streams, while the male students were more inclined to choose commerce and technology streams. To increase the number of productive citizens trained in science and technology, it is essential to increase the number of students entering into higher studies in science. As a first step the root causes dissuading students should be found, especially in educational regions which have historically performed poorly in academics.

**STRINGING THE WORDS TOGETHER:
AN ACTION RESEARCH ON TEACHING WRITING IN ENGLISH
AS A SECOND LANGUAGE (ESL) CLASSROOM**

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Learning to write in English and teaching writing to ESL students have caused multitude of problems to both the student and the teacher. Preliminary investigations revealed the students' underpinning difficulty to string the words to obtain a meaningful sentence or to translate their generated thoughts into correct linguistic form lay in their inadequate knowledge in grammar. Thus, the aim of the study was to design a teaching procedure to teach writing, utilizing the concepts emerged through second language research, mainly: the comprehensible input hypothesis (Krashen,1982, Van Pattern1987), the comprehensible output hypothesis (Swain,1995), scaffolding (Bruner,1966,1976,Vygotsky,1978), feedback (Hyland & Hyland,2006), recycling (Mayer,1983), and thereby to determine the impact of these second language concepts in improving writing.

The action research study was conducted with two samples of grade 11 students: a group of thirty six and twenty eight of different schools in varied scholastic backgrounds. Initially, the simple sentence patterns in English and basic grammar was pre taught and thereafter the content of each consecutive lesson was determined by moving through the cycle: plan, action, observation, and reflection. Focus on form activities emphasised the activity should be just beyond the learner's current competency; simultaneously, students were pushed to produce language in accordance with comprehensible input and output hypothesis. Providing required scaffolding, feedback, recycling were the teaching strategies emphasised within a lesson. Dicto gloss activities with story skeletons, picture strips as prompts forced the learners to pay attention to the linguistic form while focusing on meaning of the content.

The entry /exit tests, students' self- reports, audio recording, mini tests, portfolios and questionnaires were the data collecting tools. Analysis of data disclosed that pre teaching basic syntactic patterns of English and teaching the basic grammar, and also focusing on focus on form activities, scaffolding, feedback and recycling the lessons have helped improving writing. Further, the study showed that collaborative teaching using L1 to teach writing have also had an impact on enhancing writing.

However, the study revealed that there was a tendency for the students to write erroneous sentences when scaffolding was removed. It was also observed that the students themselves recognized their mistakes and were ready to correct them.

DEVELOPMENT OF FLOOD MAPS FOR PINGA OYA IN AKURANA AREA

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Flood hazards occur every year in many parts of the world claiming large scale of human lives and property damages. Flood modeling is employed to analyse nature and impacts of floods and to identify possible mitigation measures. *Pinga Oya* is a major tributary of Mahaweli River which inundates Akurana area very often during heavy rains. A study was carried out to develop a hydrodynamic model to generate flood levels along the *Pinga Oya* and corresponding inundation areas due to rainfalls expected to occur over the catchment at different return periods. The major scope of this study was to generate flood inundation maps for different return periods and analyse the suitability of flood mitigation measures to minimise the flood damages of the Akurana area.

Thirty four years daily rainfall data from the nearest rain gauge station, river cross section data, details on the existing hydraulic structures along the river reach and 1:10,000 topo-sheets of the study area were used. HEC-GeoHMS, HEC-GeoRAS modeling packages were used in developing hydrological and hydraulic model configurations. Stream flows at four inlets of the stream network at five return periods were derived using a HEC-HMS software based hydrological model. A one-dimensional hydraulic model developed based on HEC-RAS software was used to generate inundation depths and areas under steady flow condition for five rainfall return periods. The developed model was calibrated by comparing approximately observed flood levels at few locations in Akurana Town during a flood occurred in 2012. Flood inundation maps, with the geographical features such as roads and buildings of Akurana area, were developed for five different rainfall return periods. These inundation maps could be used to identify flood inundation areas, predict associated flood damages, and issue early warnings for minimising hardships. Suitability of lining *Pinga Oya* reach within the Akurana area as a flood mitigation measure was studied based on the model and it was found to be a suitable measure.

VIBRATION ENERGY HARVESTER FOR AMBIENT PRESSURE FORCES

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Vibration Energy Harvesting is an emerging research field focused at transforming energy in ambient pressure forces and mechanical vibrations into electricity. With free and abundant availability of ambient pressure forces, a carefully designed, optimally constructed and finely tuned vibration energy harvester could be considered as a renewable energy resource. In this paper, vibration energy harvester designed and developed to extract ambient pressure energy is presented.

The method uses a two-degree of freedom spring-mass system coupled with an electromagnetic system to harness pressure energy from and convert into electric energy. Since the electromagnetic principle is used, the optimal parameters of the harvester are estimated when the system operates at the near resonance frequencies for the targeted pressure force ranges. To accomplish this, a simulation model was developed emulating the physical process. The optimal parameters that maximize the power output were estimated from this simulation model. A device using these estimated parameters were fabricated at laboratory conditions and tested for the power output, again under laboratory conditions. Input pressure range for which the device was designed to operate was recreated and the device output was measured for each of the prominent frequency level.

It was observed that simulation model and the fabricated model agrees on the power output from the system for a given input frequency. This was encouraging since, this compatibility showcases the validity of the theoretical concept and its application. From various tests conducted on the fabricated model with varying input frequency, the maximum electric voltage of 6.5 Volts was generated when the device was subjected to a vibration of 1.82 Hz.

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EFFECT OF TRANSLATIONAL SPEED ON THE COASTAL IMPACT OF SEA SURGES INDUCED BY LANDFALLING TROPICAL CYCLONES

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Associated with extreme winds, heavy rainfall and storm surge, land-falling tropical cyclones often cause immense death and destruction in vulnerable coasts. Usually, much of the death toll and damage to property in coastal areas is as a result of cyclone-induced sea surges causing inundation of low-lying onshore lands. The height of the storm-induced surge depends on cyclone dynamics such as the wind speed, the translation speed, the angle of attack at landfall, the pressure drop and also on the coastal and shelf morphological factors such as the bathymetry and the shape of the coastline. The present paper is concerned with a numerical study of the effect of the translational speed of a landfalling tropical cyclone on the surge height and the severity of onshore inundation.

The city of Chilaw on the west coast of Sri Lanka was selected for this study as high resolution topographic data are available for this area. A hydrodynamic model based on the quadratic wind friction formulation and depth-averaged, non-linear equations of conservation of mass and momentum was employed to compute the water surface elevation (sea surge) due to cyclone induced forcing of space- and time-varying wind and pressure fields. The wind and pressure distributions due to the cyclone were computed using an axisymmetric parametric model. The model runs including high-resolution inundation simulations were carried out by varying the translational speed of a landfalling cyclone with a maximum sustained wind speed of 270 km/h, a maximum pressure drop of 80 hPa and a radius of maximum wind of 40 km. The range of translational speeds was determined based on historic cyclonic storms in the North Indian Ocean region, and accordingly, the translational speeds selected were 10, 15, 20, 25 and 30 km/h. Then, the corresponding surge heights at a location immediately offshore of the city of Chilaw were computed and the results suggest that the maximum surge height increases only slightly with the increasing translational speed of landfalling tropical cyclones. As far as the influence of translational speed on the onshore impact of a cyclone is concerned, one other vital parameter of interest is the flood volume and extent. It must be added that the peak flood volumes computed this way based on the maxima of water surface elevations at each inundated grid point are only representative since the flood volume varies temporally as well. The results indicate that the inundation extent with higher flow depths is less at higher translational speeds. Moreover, a reduction of about 35% in the peak flood volume can be seen in the case of a tropical cyclone system moving at 30 km/h compared to that at a speed of 10 km/h. This means that slower the translational speed of a cyclone as it passes over an impact area, the larger will be the amount of flood volume onshore. Accordingly, the present results appear to suggest that, although the surge height near the shoreline is affected relatively little, the onshore flood extent and volume increases with the decreasing translational speed of a landfalling tropical cyclone, thus potentially worsening the coastal impact. However, the present study is limited to one location, and therefore, further research may be necessary to arrive at general conclusions.

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APPLICATION OF SOME METHODS FOR SCREENING RAINFALL RECORDS AT SEVEN GAUGING STATIONS IN KALU GANGA UPPER CATCHMENT

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Success of a hydrological analysis highly depends on the accuracy and reliability of both procedures followed and data used during the investigation. There is a high probability of presence of errors in meteorological and hydrological data collected from various locations under different climatic conditions by diverse gauges and people with different skills and knowledge. Therefore, it is vital to check consistency, stationarity and homogeneity of hydrological data sets prior to their use in a study. This paper presents application of a set of procedures to be followed to test and screen meteorological and hydrological data series. The applicability of the procedure is demonstrated through its application to rainfall data for twenty three years (1986 - 2008) collected at seven gauging stations in Kalu Ganga upper catchment.

The screening of data at individual stations commenced with a visual check to identify missing and abnormal data records using data presented in tabular and graphical formats. Spearman's Rank Correlation method was used to test the absence of trend. Then, stability of variance and mean were examined based on 'F- test' and 'T- test', respectively. Finally, absence of persistence was checked using Serial Correlation Coefficient. The relative consistency of data among the data recording stations was tested based on Double Mass Analysis.

The screening of the data showed that the rainfall data at all the seven stations used in the study were stationary, consistent, persistent and homogeneous and thus suitable to be used in a hydrological analysis. Screening of data, prior to their use in a hydrological study, directs towards reliable and acceptable results from the study.

TORQUE ESTIMATION OF A DC MOTOR

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The electromagnetic torque of a DC motor can be measured directly by a torque sensor attached to the shaft. However, this is an expensive solution requiring additional power and interfacing and sometimes the torque sensor can be too bulky to be implemented for certain applications.

In this study we propose a method to estimate the electromagnetic torque of a DC motor using the speed measurement and the input voltage measurement in real-time. The dynamic equations of the linearized DC motor have been used to derive the State Space model. The motor parameters in the State Space model have been obtained from an experimental system identification. The identified model is used in the closed loop observer design, where the motor speed and electromagnetic torque are the selected states. The observer is used to estimate the unknown state, i.e., the electromagnetic torque.

Estimation errors occur due to the presence of measurement and plant noise. A Kalman filter is introduced to reduce the errors due to noise. In addition to the simulation studies using MATLABTM, both the closed loop observer and the Kalman filter have been experimentally verified using a DC motor test rig connected to a computer controlled system consisting of a dSPACE hardware in the loop system.

The results show that both approaches estimate the electromagnetic torque of the DC motor, while the Kalman filter estimates better in the presence of noise.

MODELLING OF GEOTECHNICAL PARAMETERS TO EVALUATE SOIL EXPANSIVITY

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Presence of expansive soils is often a silent hazard to the population and the infrastructure mainly, lightweight structures. Achieving a satisfactory evaluation of the soil expansivity requires the knowledge on the behaviour of geotechnical parameters that characterize the said problematic soil. According to geotechnical specialists of the National Enterprise for Applied Research (ENIA) in Cuba, 45% of the building pathologies of the city of *Pinar del Río* are caused by the existence of expansive soils. The main focus of this study is to present a cartographic representation of the potential expansiveness of soils with zones of different expansivity levels in the *Hermanos Cruz* neighbourhood which is located in the city of *Pinar del Río* and suggest the ways forward to mitigate potential problems of foundations associated with expansive soils.

The necessary geotechnical data were obtained from the Geotechnical Properties Database of the National Enterprise for Applied Research (ENIA) of *Pinar del Río*. The Study was carried out under the following stages: (1) Primary assessment of the potential expansiveness of soils; (2) Modelling of geotechnical parameters that characterize expansive soils utilizing 3D geostatistical methods (*Ordinary Kriging*); (3) Cartographic representation of the potential expansiveness of soils on Geographic Information System (GIS) platform at three different depth zones namely 0-1 m, 1-2 m and 2-3 m, which are of major engineering importance in the construction of shallow foundations and (4) Proposal of measures to mitigate potential problems of foundations associated with expansive soils.

The results obtained under the Stage (1), where the potential expansiveness of soils was evaluated by applying existing classification criteria based on mean values of the geotechnical parameters, indicated a “moderate degree” of potential expansiveness. However, it was difficult to determine the spatial variation of potential expansiveness of soils by the use of the above technique. Therefore, another method of examining the data, such as modelling of geotechnical parameters utilizing 3D geostatistical methods, was adopted. The geotechnical parameters; clay content, plasticity index and liquid limit were interpolated using 3D *Ordinary Kriging* algorithm which provide valuable information for integrated data analysis, in order to establish the spatial variation of the potential expansiveness of soils on GIS platform. The error value in estimating geotechnical parameters was quantified by the analysis of *Kriging Variance*. Cartographic representation of the potential expansiveness of soils was carried out in three different depth zones namely 0-1 m, 1-2 m and 2-3 m, which are of major engineering importance especially in the construction of shallow foundations. The maps generated revealed that its soils possess a medium potential expansiveness apart from some minor zones which show a high potential expansiveness. Some of the remedial measures proposed are the replacement of the existing expansive soil and the construction of an impermeable perimeter apron around the building.

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ACCURATE DEPTH MAP FROM STEREO WEB CAMERA SETUP

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When Real world scene is captured by a camera as a 2D image the information about depth is lost. To recover this, information stereo vision camera systems with disparity based depth estimation algorithms are commonly used.

In this paper, a method to calibrate and generate robust depth information from noisy stereo image pair is presented. In the calibration process a checkerboard pattern was used to estimate the camera parameters like the translation of camera 2 relative to camera 1, intrinsic matrix and extrinsic matrix of camera 1 and camera 2, rotation of Camera 2 and measurements of lens distortions. Thus an error model of each camera was constructed in order to rectify the mentioned camera distortions. Using the Stereo camera parameters, the images taken from the two cameras were rectified according to epipolar geometry. Then the disparity map was obtained from the Semi Global Block Matching Method. The depth map was generated from the disparity map using the extrinsic camera matrices.

All the algorithms were implemented in openCV and a separate tuner was developed to tune the parameters of semi global block matching method to get most accurate disparity maps. It was found that the accuracy of the depth map relies mostly on the accuracy of the calibration process. Also the Semi global block matching method works best when the images have more texture in them.

The applications of this method span from identifying geological characteristics in unknown terrains; autonomous navigation systems including unmanned aerial vehicles, unmanned ground vehicles and underwater robots; aiding mobile robots in rescue missions; gathering information from hazardous environments. The proposed method can be further developed to generate a complete 3D map of the surrounding by combining depth maps from many viewpoints.

ODOMETRY BASED POSITIONING AND NAVIGATION SYSTEM FOR INDOOR OMNIDIRECTIONAL ROBOT

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Inside an indoor environment, positioning and navigating of a mobile robot is considered as a challenging task mainly due to lack of accurate positioning system which can operate inside indoor environment. Due to poor signal conditions, general purpose positioning systems such as Global Positioning System (GPS) and Global System for Mobile Communication (GSM) fail to give an accurate position estimation. Common alternative which can be used in indoor applications are Inertial Navigation System (INS) based positioning system which uses accelerometers and gyroscopes. INS fails to give accurate position estimation when the mobile robot is under jerky motion. Also sensors used in INS have time varying noise conditions which will result erroneous position estimates. As a solution to this problem, wheel encoder based Odometric Positioning System (OPS) which tracks the mobile robot position based on the revolutions of its wheels can be used. This methodology is capable to provide accurate and stable position estimations under low wheel slip conditions.

In this paper we present a methodology of designing and implementing OPS for an Omni-Directional (OD) robot which has complex kinematics when compared to simple non-holonomic robot. First, forward kinematics of the OD robot was derived then inverse kinematic relationships was derived. Then the derived equations were implemented on a microcontroller (Atmega 2560) where it uses a well optimized algorithm to capture wheel rotations accurately via Optical shaft encoders. Using that position estimation was calculated. This implemented OPS was tested using experiments and those results validated the methodology. Results convey that accuracy of the implemented OPS was under 1 cm. Next, this OPS was utilized along with the derived kinematics of the OD robot to design a Navigation system based on position estimation feedback given by the implemented OPS. This designed Navigation system was implemented on an OD-Robot and it was validated using experiments. Results showed that it can navigate to a given target position smoothly.

OPS measurement accuracy can be affected by wheel slipping. But this can be mitigated by sensor fusing with a secondary positioning system such as INS. Proposed Navigation system tend to have fast fluctuations in orientation control even though it can control the position smoothly. This problem was solved by decoupling the orientation control from the position control mechanism. Applications of this proposed methodology spans from indoor mobile robot navigation, simultaneous localization and mapping robots to self-navigating mobile robots in reconnaissance applications. Even though this methodology was developed for indoor applications, this can be directly used in any outdoor applications even coupled with GPS or GSM like outdoor positioning systems, or to explore celestial bodies in space explorations.

LEAD (Pb) UPTAKE COMPARISON OF WATER SPINACH (*IPOMOEA AQUATICA*) AND WATER HYACINTH (*EICHHORNIA CRASSIPES*) UNDER DIFFERENT METAL STRESSES

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Increment of heavy metal concentration in the environment has accelerated due to anthropogenic activities such as mining, smelting and waste disposal. Since heavy metals are non-biodegradable, they can accumulate in the environment and pollute soil and water bodies. Many research studies found that plant species have developed an internal tolerance mechanism to cope with the high toxic metal concentrations around their habitat environment. The similar mechanism named as phytoremediation, a plant based cleansing technique is a novel, solar driven, cost effective and environmentally friendly approach for the removal of heavy metals from the environment. But as an adverse impact, metals can be contaminated in food chain through plants. Long-term exposure to toxic metals through edible plants causes neurological difficulties and cancers in human. Investigations of heavy metal removal by diverse plant species have conducted by many researchers under different conditions. Therefore it is important to analyze the metal absorbing characteristics of edible plants. This research is based on lead (Pb) uptake capability of the edible plant, water spinach. Simultaneously, a non-edible plant, water hyacinth is also employed to compare the rate of up take. Plants were introduced into solutions containing 0, 2, 4 and 8 mg/l Pb and 25% Hoagland's nutrient solution. Plants were allowed to grow for a period of 15 days and both species did not show any phytotoxic effects.

The overall uptake of Pb in plants has increased with the Pb concentration in the feed solution. The average metal uptake of *Ipomoea Aquatica* are 0, 0.17, 0.43 and 0.61 mg/g (dry weight) and that of *Eichhornia Crassipes* are 0, 0.59, 1.43 and 2.58 mg/g (dry weight) respectively in 0, 2, 4 and 8 mg/l of Pb in the feed. Metal contaminated in roots were higher than shoots in both species and this difference is statistically significant ($p < 0.05$). The translocation factor below unity in all situations signifies that greater amount of metal was sequestered in the root vacuoles than translocating to the aerial parts and thus says that they are non-hyperaccumulators for Pb. When comparing both species, water hyacinth has up taken greater amount of metal than water spinach. But the translocation factor of spinach is greater than hyacinth meaning that even though they are grown under the same conditions the edible plant's efficiency of translocating metal to shoots is greater than the non-edible. However it can be said that growing the edible plant together with hyacinth will reduce Pb uptake by spinach and thus reduce contamination in food chain.

PERFLUOROCTANESULFONIC (PFOS) COMPOUNDS IN SRI LANKA – SOURCES AND QUANTIFICATION

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PFOS (perfluorooctanesulfonic acid or perfluorooctane sulfonate) is unusually stable due to its Carbon-Fluorine bonds, making it a highly persistent organic compound which does not degrade easily. It bio accumulates and magnifies along the food chain causing hepatotoxicity, immunotoxicity, reproductive and development problems, neurotoxicity and potentially tumorigenicity of the liver, thyroid, pancreas, bladder and breasts in humans. PFOS and its precursors are released to environment during use, manufacture and disposal of products containing them. It is water soluble, thus it can migrate readily from soil to groundwater and eventually transport long distances through water bodies. Owing to these reasons, PFOS has been included in the list of persistent organic pollutants by the Stockholm Convention. Several investigations indicate that Sri Lankan water bodies contain PFOS mainly due to industrial usage of PFOS during manufacture or waste disposal. Therefore there is a need to study the use of PFOS in Sri Lanka. The objective of this study was to estimate the amount of PFOS imported into Sri Lanka, to assess how aware society is of PFOS and to assess the potential environmental and health issues due to usage of PFOS in Sri Lanka. This is the first time in Sri Lanka that a comprehensive inventory of PFOS has been taken. Import data related to PFOS containing products were obtained from the Custom office in Colombo. Their complete database was initially screened to select import data for the year 2013. The list of contaminated sites was obtained from the Central Environmental Authority (CEA). In order to assess societal awareness, a questionnaire-based survey was carried out among industries and necessary information were collected. For the metal plating, photolithography and semiconductor industries, the amount of PFOS imported was negligible. PFOS in fire-fighting foam imported ranged between 7,072 – 21,217 kg/year. The photography industry imported 43.67 kg/year of PFOS while hydraulic fluids for aviation imported was in the range of 23.63-47.25 kg/year. Textile industry showed a range of 571.14-5,771.39 kg/year of PFOS imports and carpet protection showed 1,288.61-12,886.13 kg/year. Cleaning products, wax and polish showed a range of 379- 785 kg/year of PFOS import. The western province showed the highest percentage of solid waste disposal as well as PFOS emission to the environment. The questionnaire-based survey identified that the industrial community was unaware of PFOS. Given this lack of awareness it is important to track the amount of PFOS imported into Sri Lanka and government agencies should be made aware of this issue. Likewise, awareness programs need be conducted for society as a whole on PFOS. Additionally, contaminated sites should be controlled and stocks of PFOS containing products should be carefully monitored for leaks. Furthermore, alternatives for PFOS can be used in order to minimize PFOS contamination. These steps will help to reduce risk from PFOS in Sri Lanka.

A SYSTEM TO DETERMINE DYNAMIC RATINGS OF POWER DISTRIBUTION LINES

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In response to climate change, many governments have set ambitious targets to increase the use of renewable energy and to reduce greenhouse gas emissions from electricity generation. As most of the renewable resources are concentrated often in remote locations, their development is hindered by the bottlenecks in the distribution networks. Relieving these bottlenecks required a mechanism to increase the power flow capability of existing lines. Former requires unprecedented amount of capital investment. Later usually called as the operation of the lines based on dynamic line rating has been researched and basic methods are established. With the initiation of the Smart Grid technology, there has been an interest to utilize dynamic line ratings to operate distribution networks optimally while maximizing the power generation from renewable energy sources.

The sensing device was developed to measure the ambient temperature, conductor temperature and line current of overhead power lines. A system that can determine the dynamic line rating was developed using low cost solutions. GPRS communication is used to transmit data from sensors located on the power lines and these data and the parameters of the line are used to determine the dynamic line rating. This dynamic line rating system was first implemented and tested in the laboratory. Then it was enclosed in a suitable enclosure and suitable field tests are carried out on a 400V overhead line. An algorithm was implemented in MATLAB/Simulink to determine the line rating using the gathered data. According to the results the dynamic line rating observed to be higher than the static rating of the conductor which is used in the existing power system. Using the practical implementation done, optimizing the addition of the renewable energy resources can be introduced to the distribution network.

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DISTRIBUTION SYSTEM VOLTAGE REGULATION USING A SERIES COMPENSATOR

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It is foreseen that with the increased penetration of micro scale renewable generation sources, electric vehicles and demand response initiatives, the voltage of low voltage networks need to be controlled in real time. Otherwise large voltage variations on a feeder that cause high and low voltage at the customer delivery points may result thus deteriorating the voltage quality throughout the distribution network. A worthy voltage regulation scheme can enable a utility to control voltage levels on its feeders.

Furthermore, the demand to some extent depends on the voltage level and therefore the voltage control becomes an important means of load control. Consequently the voltage regulation secondarily affects the load control especially at peak load periods.

Commonly used method of voltage control is on-load tap changing. Different approaches of solid state tap changes for voltage control of distribution networks are proposed in the literature. Some presents a method in which a number of series windings were connected with the secondary winding of a transformer through a 4-quadrant converter. Using three series and a combination of series and parallel windings taps from 0.5% to 10% were achieved. Also, number of references present a tap changing transformer using a back-to-back thyristor switches to switch between taps. These designs require power electronic switches that have the same current rating as the transformer.

Due to the limitations in existing methods, an electronically controlled series compensator scheme based on a three winding transformer was investigated. A simple radial network with two loads was considered to assess the effectiveness of the proposed schemes. The feasibility of the proposed approach with an open loop controller was verified with both theoretical and simulation studies. From the simulation results in the PLECS simulation environment it was shown that in order to maintain the voltage within the specified limit, the voltage source converter should be actively controlled with the feedback of the system. Also, it is important to optimize the size of the injecting transformer in order to incorporate with the existing distribution substations. Therefore, further work should be carried out with a more realistic transformer design with detailed representation of the VSC and its closed loop controllers.

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USE OF SURFACE MODIFIED SILICA IN REINFORCING A SYNTHETIC POLYMER LATEX

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Carboxylated acrylonitrile butadiene rubber (XNBR) latex is a widely used synthetic polymer latex. Synthetic elastomers are typically not self-reinforcing elastomers. Hence silica is used as reinforcing filler in making white colored products. Silica alone would not function as an effective reinforcing agent mainly due to the aggregation of silica particles resulting from strong attraction between surface groups of silica. Natural polymers (NPs) like Cellulose, Gelatin, Chitin and Chitosan used as suitable materials for silica surface modification with a view to discourage filler/filler interactions while encouraging rubber/filler interactions in XNBR lattices.

A synthetic Low Ammonia XNBR Latex sample of 45.28 % dry rubber content (DRC) , commercial grades of precipitated silica (VN3), Zinc dithiocarbamate (ZDC) , KOH, HCl, ZnO, Lauric acid, Styrenated Phenol, a commercial grade of Cellulose and a food grade of Gelatin and raw shrimp shells were used in this study. Chitin and Chitosan were extracted from locally available shrimp shells through demineralization, deproteinization followed by de-acetylation processes. Surface modification of silica with NPs was carried out using an in-situ surface technique where filler and NPs in the form of powder were converted to dispersions by ball milling. All ingredients were either in solutions or dispersions and then added to the XNBR latex. Latex films cast from compounds were then vulcanized at 70 °C for 10 minutes. The extent of reinforcement was evaluated by tensile, tear and cross-link density measurement tests.

Chemical analysis confirmed that silica surface has been modified by Chitin natural polymer with the inherent high thermal resistance property. Dispersion stability test confirmed the dispersion stability of Chitin modified filler was better than that of unmodified dispersion. Some of the mechanical properties important for certain rubber latex applications, like tensile strength, of Chitin modified silica filled cast films were found to be improved over unmodified silica filled cast films. The Vulcanizates containing Chitin modified filler at 10 phr loading were found to give optimum tensile strength values which were above the corresponding values of unmodified filler containing Vulcanizates. Cross link density measurement test confirmed the high amount of cross links formed in Chitin modified filler filled XNBR latex compounds at 10 phr filler loading together with improved rubber filler interactions in XNBR matrix. Morphological studies done by scanning electron microscopy illustrated improved rubber filler interactions in Chitin modified filler filled XNBR latex films at same filler loading. The observed results verified that Chitin is capable of enhancing reinforcing action of silica fillers in XNBR latex compounds probably by discouraging filler/filler interactions and encouraging rubber/filler interactions.

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EXTRACTION AND CHARACTERIZATION OF MONTMORILLONITE NANO PARTICLES FROM NATURAL CLAY DEPOSITS

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Clay deposits in the dry region in Sri Lanka have been mined for generations for the rich clay content that can be used in variety of applications. The typical usages of the clay mined from this region were mainly restricted to brick, tile, and traditional cookware manufacturing. Previous research done on these deposits have yielded that these deposits mainly consist of Kaolinite and Montmorillonite clay mixed with different impurities.

Montmorillonite which belongs to the smectite clay group has applications mainly in the field of polymer-clay nano composite fabrication. Composites synthesised by infusing Montmorillonite nano particles in the polymer are known to show superior mechanical properties otherwise not possible to achieve.

This research was mainly focused on the extraction of these Montmorillonite nano particles from the clay deposits located in the dry region in Sri Lanka, which can be used in the fabrication of polymer-clay nano composite. The extraction technique was based on sedimentation and centrifuging techniques, which was possible because of the difference in specific gravity of Montmorillonite.

The results of primary analysis revealed that the analysed clay specimens were mainly consisting of Kaolinite and Montmorillonite, which concurs with previous research findings, and the main impurity being quartz. The final resultants were analysed for the presence of Montmorillonite, and it was found that it contained Montmorillonite and no considerable amounts of Kaolinite which shows that the two minerals have been separated.

OPTIMISING ELECTRIC VEHICLE POWERTRAIN COMPONENTS FOR ENHANCED PERFORMANCE

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Electric vehicles are a promising alternative to vehicles powered by fossil fuels due to their zero emissions feature. However, the limited specific power of the batteries in the electric vehicles, add a considerable weight which limit their performance. This drawback has affected the market share of the electric vehicles negatively, as they find it difficult to compete with fossil fuel powered counterpart in this respect.

In this study, we model the electric vehicle powertrain starting from the fundamentals, use real electric vehicle component data and analyze the trade-off between battery parameters against vehicle performance for ARTEMIS, NEDC and Cranfield drive cycles. Further, supercapacitors with high power density are added in parallel with the battery in order to compensate the low power density deficiency in the battery.

However, the introduction of the supercapacitor affects the overall weight of the vehicle which is very critical for electric vehicles. Therefore powertrain component optimization is mandatory to put the concept effectively in action. This paper presents improving the range and the maximum acceleration of the electric vehicle by introducing the supercapacitors to the electric vehicle powertrain where the battery is used as the main power source and the use of linear optimization to reach a practically viable solution in selecting powertrain components. Further the analysis is done in the MATLAB platform.

A simple optimization reveals that the addition of supercapacitors enables reducing the overall mass of the power source of the vehicle and increasing the performance i.e., maximum acceleration, at the price of reduced stored energy. Further it reveals that the specific energy of the battery supercapacitor combined case is higher than that of battery alone case, meaning that the overall range is increased by adding supercapacitors.

INDOOR NAVIGATION USING INERTIAL NAVIGATION SYSTEM MEASUREMENTS

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Indoor navigation is considered to be one of the main challenges faced in mobile robotics. The reason is that the methods that can be used for this application give out erroneous results in varying motion conditions. For example the odometric measurement techniques which use measurements obtained by the wheel revolutions fail to give accurate results in slipping conditions. The other popular navigation techniques like Global Positioning System (GPS), Global System for Mobile Communication (GSM) will not give out accurate results due to attenuation of signals in indoor environments. As a solution for this problem, this paper discusses a methodology to use Inertial Navigation System (INS) measurements and utilize these measurements to obtain accurate position and orientation estimates in indoor environments.

The INS is consisting of tri-axis accelerometer and a tri-axis gyroscope. Here, the MPU-6050 accelerometer unit is employed. The tri-axis accelerometers measure the accelerations with respect to the local frame of the mobile platform. The tri-axis gyroscope measures the yaw pitch and roll measurements, which are the rotational velocities about the Z, Y and X axes respectively in the global frame. The measurements taken from the accelerometer and the gyroscope consisted of inherited weaknesses like bias and noise. These weaknesses have to be mitigated in order to obtain an accurate estimate for the position, velocity and orientation. Here, in order to remove the bias of the measurements, the accelerometer and the gyroscope readings were sampled and averaged while the robot was kept stationary and the bias vectors are obtained. The bias vector was subtracted from each of the measurements obtained from the sensor respectively. The bias calibrated accelerometer measurements were still corrupted heavily with noise. Therefore an analysis of the noise was done and using the characteristics of the noise accelerometer measurements were filtered using a *Kalman filter* in order to reduce sudden fluctuations due to noise.

The bias and noise correction algorithms successfully removed the bias and the noise from the accelerometer and gyroscope measurements. The algorithm was further developed in order to enable real time operation to correct the errors in the measurements. The output position and orientation estimates were recorded for different movements and the actual and the estimated results were compared. Here, it was seen that the estimated values follow the actual values with a reasonable accuracy. In order to further increase the accuracy, the INS system can be used coupled with the odometric measurement system so that the algorithm could exclude the inherited weaknesses in both the systems.

Applications of this indoor navigation system spans from autonomous navigation systems to navigating mobile robots in rescue missions and hazardous environments. Even though this methodology was developed for indoor navigation of units on a flat surface, it can be extended to any 3D motion such as in Unmanned Aerial Vehicles (UAVs).

CONVERSION OF USED HEAVY FUEL OIL AND LUBRICANT ENGINE OIL MIXER INTO LUBRICATING GREASE

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Used engine oil is discarded into ground without considering its resource value. Also it causes serious environmental pollution. Reusing the used oil with necessary treatment can conserve this resource while protecting the environment. The objective of this project was to remove degraded additives and contaminants from waste oil and then use it as a base oil to produce grease.

Waste Heavy Fuel Oil (HFO) and lubricant oil was collected from chunnakam power station. Initial ash content of waste oil was >0.6wt%. Collected oil was heated up to 400°C for an hour to remove water and other volatile particles. Then it was decontaminated using Acetic acid. There are many advantages of using acetic acid to remove metals from used oil over other available methods. Its cost is very low, it does not affect the base oil structure and only reacts with metals, and environmental pollution can be controlled.

It was found that 2 ml of acetic acid reduces ash content by less than 0.1wt% at room temperature. Treated oil was used as base oil to prepare grease. Grease obtained by adding 10% Na + 5% Ca soap to the base oil had a viscosity of 3888 (mPa.s) and dropping point of 150°C. The D 4980 ASTM standard test was conducted to compare the grease quality and the resulting grease satisfied the GA type grease. If other tests are also conducted it may be possible to show that the prepared grease could be used as general purpose grease. Different types of grease can be obtained by changing the composition of thickeners.

In industrial point of view, it costs around 200 LKR to produce 1 Kg of grease while the market price is about thrice of the product cost. This project work is planned to be implemented after designing necessary machineries.

Since petroleum products are not renewable, converting used oil waste to grease with necessary treatment is the best solution to produce grease at a low cost, At the same time it will minimize the environmental pollution.

APPLICATION OF THE COUPLED ENERGY SIMULATION AND COMPUTATIONAL FLUID DYNAMICS APPROACH FOR PREDICTING ENERGY PERFORMANCE OF BUILDINGS

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Buildings account for nearly 40% of the global energy consumption and hence presently high emphasis is placed on improving the energy performance of buildings. Energy Simulation (ES) is the most popular approach in predicting the energy performance of buildings during their conceptual design stage. However, it is observed that this methodology shows certain inherent deficiencies in predicting the energy performance of buildings. *Energy Simulation* tools do not have the capacity to model air circulation through the building space explicitly. *ES* tools mainly rely on the simplifying assumption that air within a thermal zone of a building is *well-mixed*. Furthermore, convective heat transfer coefficients of building surfaces are calculated using set empirical correlations. Literature also reveals that most *Energy Simulation* tools under-predict energy consumption in buildings, especially under sunny conditions. On the other hand, Computational Fluid Dynamics (CFD) tools can predict airflow field, velocities, relative humidity and contaminant concentrations within an occupied space of a building extensively and accurately. Also, they are capable of determining the temperature distribution within the building space and convective heat transfer coefficients of the building envelope. However, CFD simulations need to be provided with the corresponding boundary conditions of the computational domain, which are readily available in the Energy Simulation approach. On this basis, the paper explains how *Energy Simulation* can be coupled with Computational Fluid Dynamics in predicting the energy performance of a building more accurately through complementary data exchange between the tools. The office building considered in the study is to be constructed in the suburbs of Colombo. The analysis uses ENERGYPLUS 8.0 and ANSYS FLUENT 6.3 as the tools for conducting Energy Simulation and Computational Fluid Dynamics respectively. MATLAB R2012a establishes the coupling platform. The study shows that the coupled approach predicts considerably higher energy consumption for the building compared to that given by conventional Energy Simulation using ENERGYPLUS.

INTERPOLATIVE FINGERPRINT MATCHING TECHNIQUE FOR INDOOR LOCALIZATION

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Indoor localization has become a popular research area due to the increasing demand for location based services with the development of mobile phone technology. Traditional outdoor localization techniques such as GPS (Global Positioning System), which rely on time of arrival (TOA) techniques cannot be used for indoor localization due to the presence of non-line of sight (non-LOS) and multi-path conditions in indoor environments. It was due to this fact that the technique of fingerprinting was developed.

Fingerprinting is basically a pattern matching technique where the fingerprint or signature of an unknown location is matched with a set of fingerprints corresponding to known locations and the unknown location is estimated. The process of fingerprinting consists of two phases: the initial offline phase where measurements are taken at known locations in the indoor environment and a radio map and fingerprint database is constructed, and the online phase where measurements at unknown location are taken and matched with the fingerprint database to estimate the unknown location. The fingerprint and radio map database used for this study was constructed based on audible sound measurements made in an indoor environment.

The most popular technique used in literature to estimate an unknown location by matching fingerprints is the weighted k-nearest neighbours (WkNN) algorithm. However, WkNN was unable to give satisfactory results for the fingerprint and radio map database used in this study. Hence, an interpolative matching technique was used, which gave much better results compared to WkNN. This study explores the possibility of using interpolative techniques for fingerprint matching.

RUNOFF MODEL DEVELOPMENT FOR NILAMBE CATCHMENT IN SRI LANKA USING HEC-HMS

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Assessment of catchment runoff plays a vital role in catchment management. Hydrologic models are used as tools to simulate hydrologic processes and estimate catchment runoff parameters. But it is a challenging task to calibrate such models to represent real situation due to the limited data availability. In this study, Hydrologic Modeling System (HEC-HMS), developed by the Hydrologic Engineering Center, USA has been used to set up run off simulation model for the Nilambe catchment of the Mahaweli River located upstream of Polgolla reservoir in Sri Lanka. The Nilambe catchment was selected due to its importance to hydropower generation by Nilambe Hydropower Plant installed utilizing the runoff of the catchment.

The Nilambe catchment was divided into 17 sub-catchments considering the hill-slopes and stream network. Clark unit hydrograph was selected as transport method with relevant time of concentration values for sub-catchments. Initial and constant loss method was used for flow calculation and constant loss value and imperviousness were used as calibration parameters. Recession base flow method with ratio to peak threshold method was selected to calculate base flow.

The model was calibrated for a period of one year from 01 April 1992 to 30 March 1993. The validation of the model was carried out for the period from 01 November 1993 to 31 October 1994. Calibrated model suggests a constant loss rate of 5 mm/h and percentage imperviousness of 28% for the initial and constant loss method. The recession constant of 0.98 and the peak to ratio of 0.18 of the threshold method was used. The calibrated model is a useful tool for water resources development planning in the Nilambe catchment or similar hilly catchment in the Mahaweli basin.

The model was used to generate daily runoff of the Nilambe catchment for 20 years period from 1976 to 1996, and the flow duration curve was developed. It is found that the energy output from the Nilambe hydropower plant can be increased by about 18% with a Plant factor of 30% by increasing the design discharge to 6.3 m³/s from present 3.6 m³/s.

PD SIGNATURE IDENTIFICATION USING RF ANTENNA FOR CONDITION MONITORING IN POWER TRANSFORMERS

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Power transformer is a vital component in a power system. So to maintain the reliability of the power system, continuous condition monitoring of the power transformer is essential. To monitor its condition, one of the best ways is to monitor the status of partial discharges (PDs) appearing in the transformer. With aging of power transformers in the service, their insulation may get aged. As a result, PD may occur in the transformer as corona discharges in air cavities or in oil, or as surface discharges in its insulation interfaces etc. This paper deals with monitoring and analyzing of common types of PD patterns occurring in a power transformer.

In this paper, a Radio Frequency (RF) antenna was used to detect the electromagnetic signal generated due to three types of PDs i.e. corona in air, corona oil and surface discharge at interface. With preliminary investigations of different types of RF antennas by trial and error method, a loop antenna of diameter 200 mm was selected for the study. The three types of PDs were generated from laboratory set-ups. The corona set-up in air was prepared by a point plane gap with a gap setting of 20 mm whereas corona in oil was generated by dipping the same set-up in an oil container. The surface discharges were generated by keeping a transformer pressboard of thickness 5 mm between rod plane electrode system. Measured breakdown voltages for the setups used to generate corona in air, in oil and surface discharge were 25 kV, 30 kV and 10 kV respectively. The loop antenna was placed 1 m away from the setup and the captured RF signals were observed using a spectrum analyzer (anritsu-MS2661C-range 9 kHz-3 GHz) at different voltages up to 1 kV below the respective breakdown voltages. The antenna was aligned in such a way that the magnetic field generated by the PD was perpendicular to the plane of the loop.

In preliminary investigations, it was identified that the presence of the PD signal was high in 5 to 60 MHz frequency range. After analyzing the final results which were taken 1 kV below the respective breakdown voltages of each PD types, the power spectral density distributions were compared.. The highest peaks of three responses were observed at 9 MHz, 8 MHz and 8.5 MHz for corona discharge in air, corona discharge in oil and surface discharge respectively. Their magnitudes varied as 22dBm, 19 dBm and 17 dBm for corona discharge in air, corona discharge in oil and surface discharge respectively. When the HV supply was decreased the magnitudes of the spectral responses were reduced. It was found that the PD strength varied with the supplied voltage level. It can be concluded that RF antenna can effectively be used to identify different PD patterns.

DESIGN OF THE BUCK CONVERTER FOR A CURRENT CONTROLLED PHOTOVOLTAIC EMULATOR

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The modern developing world is inclining more towards renewable energy. Photovoltaic (PV) systems are a major renewable energy source. A number of PV panels are commercially available with different voltage and current ratings. Different PV modules should be used in different applications depending on their power demand, environmental constraints and the nature of the existing power system. It is necessary to test these systems prior to installation as well as for research purposes. It is infeasible to do this testing using actual PV panels as the PV panels are expensive. A PV emulator can be used in these testing purposes. PV emulator is an electronic device which mimics the characteristics of a PV panel under different environmental conditions. PV emulators based on various technologies have been proposed over the years. This design gives a low cost PV emulator integrating a buck converter, a current controller and a PV model. In the proposed system, a current controller takes the inductor current of the buck converter as a feedback and it compares with a reference current. The error is fed to a PI controller which is used to generate the Pulse Width Modulated (PWM) signal. The reference PV current is generated by a PV model that takes temperature, irradiance level and output voltage of the buck converter as inputs.

This paper presents the design and simulation of a buck converter for the photovoltaic emulator. The basic equation related to the components of the converter is derived. Initial design was done for a PV panel with Maximum Power Point (MPP) current of 1.1 A, MPP voltage of 17.5V, short circuit current of 1.2 A and an open circuit voltage of 22.4V. The converter was designed to operate at the MPP. The designed converter was simulated using EMTDC/PSCAD software. As the PV panel operates at two extreme conditions (open circuit condition and short circuit condition), the behavior of the converter at these two extremes were analyzed. The converter was designed to have inductor current ripple of 30% and output voltage ripple of 5%. The simulation shows that the designed buck converter can achieve the desired output current with a ripple below 30% and output voltage at a ripple below 5% throughout the characteristic curve. This concludes that the designed converter can be used to obtain the required output current and voltage in generating the current-voltage characteristics of a PV panel with an acceptable accuracy.

PV INVERTERS TO ENHANCE THE UTILIZATION OF AC NETWORKS

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In many LV distribution networks, voltage drops in distribution lines causing many problems for sensitive equipment connected to these lines. The issue of poor voltage profile on distribution lines may be severe with the connection of electric vehicles as users will start charging them after returning home. As a solution to this problem, in this paper a reactive power compensation mode of PV inverters is investigated. Number of PV installations is rapidly growing and grid tie PV inverters operate only during the day time. In this project PV inverters are to be used to inject reactive power to the system at night, thereby enhance the voltage profile of distribution lines.

During the day time, active power generated by PV panels is delivered to the system through the PV inverter. Any excess capacity is used to supply reactive power. At the night since PV panels are inactive, full capacity of the inverter is used to generate reactive power.

The flow of active power through the PV inverter is controlled by applying an appropriate phase shift to the inverter output voltage with reference to the line voltage. In order to control the reactive power flow, the magnitude of the inverter output voltage is varied with respect to the magnitude of the distribution line voltage. If inverter output voltage magnitude is maintained above that of the distribution line, inverter can be operated as a reactive power generator. And also it can be operated as a reactive power consumer if necessary.

A controller for the PV inverter which regulates the active and reactive power was developed. Inverter output current was measured and depending on the measured current, two orthogonal time invariant dc components as direct component and quadrature component were derived. These components were controlled to follow the given current references such that active and reactive power flow can be regulated independently. The operation of the concept was proved by simulations. Accordingly, PV inverters can be used to maintain a proper voltage profile along distribution lines by supplying reactive power on demand. It will also enhance the utilization of distribution network and the productivity of PV inverters.

FREQUENCY DOMAIN ICA BASED SIGNAL RESTORATION FROM NON-LINEARLY DISTORTED ACOUSTIC SIGNALS WITH DROPOUTS

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Independent Component Analysis (ICA) is a class of blind source separation which can be successfully used for extracting unknown independent source signals from acoustic signal mixtures. In this study, we introduce a new process based on frequency domain complex valued ICA for separation of sound sources from a distorted set of acoustic signals with random dropouts/audio gaps of the same source. The conventional time domain ICA algorithms can be effectively used for extraction of sources under linearly mixed conditions. However, the time domain algorithms are incapable of extracting the source signal under non-linear conditions. Therefore, our new method is targeted for extracting acoustic source signal when several non-linearly distorted and corrupted audio signal samples are available. It was also found that the frequency domain algorithm has a superior performance compared to the conventional real valued time domain ICA algorithm. Therefore, this algorithm can be used as an effective method for acoustic signal processing applications.

ASSESSMENTS OF THE IMPACT OF DEDURU OYA LEFT BANK CANAL ON THE CROPPING INTENSITY OF THE EXISTING IRRIGATION SYSTEMS

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Deduru Oya region in Sri Lanka experiences highly variable flow patterns which pose a challenge to water resource availability and distribution. The rainfall in the basin has a significant temporal variation and thus the flow in the Deduru Oya carry flash floods during rainy season and very low flow during dry season. There is need to store flood water carried by Deduru Oya for use during lean season especially for irrigation. The multi-purpose proposed Deduru Oya reservoir constructed across the Deduru Oya will have 75 MCM and the proposed irrigable area under Left Bank (LB) canal is about 3000 Ha. This study aims to assess the cropping intensity of LB canal area considering current and future water supply, demand status and water allocation with focus on irrigation water requirements.

This study develops a model for water management in Deduru Oya LB canal development area to study the possible water allocations of Deduru Oya LB canal irrigation system. Hydrological Engineering Center-Hydrological Modeling System (HEC-HMS) is used for hydrological simulations and CROPWAT model is used to estimate crop water requirements. Water Evaluation and Planning (WEAP) model is used for water balance simulations in Deduru Oya LB canal development area. Lump model results reveal that the cropping intensity in the proposed irrigable area at LB canal will increase from 30% at present to 100% with the proposed Deduru Oya reservoir.

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FACE AND EMOTION RECOGNITION USING EIGENFACES WITH PROBABILISTIC AND SIGNAL CROSS CORRELATION METHODS

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Face recognition is very challenging due to the huge amount of details inscribed within a human face. Therefore it is an onerous task to develop a computational model to identify a person under various physical conditions. It is also worth noting in general that face recognition is not robust when mixed up with emotions. Thus we address the problem of human face identification and emotion recognition under various illumination levels and different geometric positions of head to propose a robust system of recognition. This paper presents a novel approach to the problem of human face and emotion recognition based on information theory, probability and signal processing techniques.

The proposed methods are clusters of several approaches drawn in by a feedback path which provides a uniquely defined system for each of the training database. The conventional Principal Component Analysis (PCA) based methods use the projections of face images onto a feature space defined by the “eigenfaces” corresponding to the largest eigenvalues which claims to best encode the variation between the known faces. In contrary to the above mentioned approach where the feature space is a set of prominent eigenfaces, we propose a method that learns the feature distribution of the face database and decide on the set of eigenfaces suitable for defining the feature space.

This unique feature space produces the projection of each known faces which are compared against the unknown faces based several approaches. The final conclusion on the result is made on the individual result. The stage of comparison between known faces and the unknown faces can be explained as the similarity matching techniques. As the name suggests our approach consists of three methods to define the similarity criteria. They are Euclidian distance between the projections of known and unknown faces, cosine angle between the projections considering them as vectors and correlation of the projection coordinates considering them as signals.

The decision on the recognized face is made using the probability of match corresponding to each of the classes by each of the similarity techniques. Since the feature space defined by our approach arguably proves the provision of the essential variation between the classes, this same algorithm can be used to identify emotions of faces based on known emotional states. This stands as another important aspect of the proposed method because of its ability to produce satisfactory results for both face and emotion recognition. The proposed algorithm has produced an average recognition accuracy of 92.4 % and an average false positive occurrence rate of 10.2 %.

Not Presented

AN APPLICATION OF MULTI LEVEL DC-DC CONVERTERS TO MITIGATE DYNAMIC SHADING ON PV CELLS.

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It is anticipated that the photovoltaic (PV) will become one of the major energy source in the future vehicles. At present, Ford has created a hybrid vehicle that uses a PV system to charge its battery. Rooftop PV panel on a car reduces the transfer of heat into the cabin by solar radiation in hot climates thus reducing the heating of air temperature inside the car. However, efficiency of rooftop PV panels on cars will reduce with shading. As the shading is dynamic on a car roof, an effective way of overcoming shading is a must.

If a cell in a PV string, where all the cells are connected in series, is fully shaded, the current going through the string will be zero. If it is partially shaded, the current going through the string will be determined by the current going through the shaded cell. The most common PV shading mitigation technique is the by-pass diode technique. Even though different techniques exist to mitigate shading, it becomes challenging if the PV panels are moving such as the one on a PV powered electric car.

A multi-level DC to DC converter that can mitigate PV shading dynamically is investigated in this project. The proposed mitigating technique is practically implemented with four PV modules that are connected through buck converters. In this method, each output of the PV cells is connected to a buck converter. The outputs of the buck converters are connected in series to increase the output voltage. Each buck converter is controlled such a way that maximum power is extracted from each cell. Therefore even under shading conditions controller will set to get the maximum power from the particular shaded cell rather than electrically removing it from the cell. In this circuit each PV cell can be controlled separately and it is an advantage because the cells, which are not shaded, are also producing no power from the string in the conventional techniques as they are not separately controlled. By including extra cells and increasing the number of cells, the effect of the shaded cell can be neglected from the output.

Not Presented

Not Presented

EFFECTS OF SAMPLE SIZE IN PREDICTION OF EXPECTED EMPLOYABILITY SKILLS OF ENGINEERING GRADUATES

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Identifying important employability skills expected by employers of different engineering disciplines are vital in getting a good employment for fresh engineering graduates. Having prior awareness of required employability skills will immensely help fresh graduates to develop their career and transit smoothly from academic environment to working environment. In addition, this information will be very useful in development and revisions of engineering courses. The use of appropriate sample sizes in a statistical analysis may influence the reliability and consistency of the prediction of employability skills. From this point of view, this study is focused on examining the effects of sample sizes in the prediction of employability skills of engineering graduates. The data collection was carried out through a questionnaire survey to measure employer perception on specific attributes of an engineer. The employers were from civil engineering organizations where fresh graduates are typically recruited. The questionnaire included twenty eight specific attributes covering thirteen under Technical Skills and fifteen under Non-Technical Skill. These attributes were identified through the Accreditation Manual of the Institute of Engineers, Sri Lanka (IESL) which complies with the Washington Accord requirements and also from relevant literature. Each attribute was measured using a five-point Likert scale ranging from 1 to 5. Basically, Principal Component Analysis (PCA) and Factor Analysis (FA) were used in reducing large number of variables (specific attributes) into few underlying factors (employability skills). The communality values estimated through these analyses were considered as the key indicators that represent the degree of association of each and every attribute in the extraction of employability skills. Consistency of communality values for different sample sizes such as 25, 48, 75, 100 and 122 were examined using PCA and FA based on Pearson and Polychoric correlation matrices considering continuous and discrete behaviour of the data respectively. Initially, dominant Eigenvalues (>1) found from the correlation matrix which represent the variance of each factor in the structure were considered for deciding the number of factors retained. This criterion was eventually changed for some cases by incorporating factors with the next less dominant Eigenvalue (<1) in order to improve the model fitness.

Of the two correlation methods used, Polychoric correlation method estimated little higher correlation coefficients compared to Pearson correlation method and it provided better communality values in the factor extraction process. From the results, it was found that the communality values of attributes based on Pearson correlation using PCA and FA tends to show consistent at the sample sizes above 48. At the sample sizes below 48 such consistency cannot be seen in the communalities due to the existence of higher correlation coefficients due to similar response patterns in pairs of attributes. The consistency of communality values based on Polychoric correlation shows a similar trend as Pearson correlation for PCA while FA shows a consistent trend only above the sample size 100. Thus, it can be concluded from the results that the analyses should be performed for sample sizes greater than 100 to have reliable and consistent prediction of expected employability skills of engineering graduates.

A STUDY OF DYNAMIC AQUATIC BACKGROUND CONDITIONS FOR FOREGROUND ESTIMATION USING PIXELWISE ONLINE CLUSTERING

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Event detection using videos is a field which has seen many improvements in the recent past. There are wide ranging applications including security surveillance, traffic surveillance, coastguard and lifeguard support systems and biometric information capturing systems to name a few. The essential steps used in algorithms for these tasks are foreground detection and background subtraction followed by object tracking. Background subtraction is one of the most important stages since its results determine the inputs to the later stages. Therefore robust background removal techniques have great value for event detection.

There are many methods developed for background subtraction. However, the more commonly used algorithms are based on motion detection since this removes the need to have prior knowledge of foreground objects. Many of these are pixel-wise algorithms that can be implemented using parallel processing architectures. This gives the potential to implement very complex algorithms for background subtraction in real time.

In pixel-wise methods, data in individual pixels arriving with time is separated using online clustering techniques. Here multiple parametric models are constructed and the data is matched into them. Therefore a proper understanding of the statistics of the distribution of data is essential in order to construct suitable parametric models.

One of the most commonly used models is the Adaptive Gaussian Mixture Model which matches the data to a set of spherical Gaussians. However other distributions such as the cylindrical distribution model exist, that can capture changes in lighting and distributions from moving cameras. The latter model uses cylinders that have their axes going through the origin of the RGB space, giving simplified parametric structures. However these models fail when they are used for foreground detection in dynamic aquatic conditions with sustained ripples.

In this work a study of the pixel distributions in the RGB color space for dynamic backgrounds in certain types of aquatic conditions is presented. Videos captured from a multitude of places have been studied. These include controlled conditions in laboratories as well as outdoor scenarios such as in swimming pools, lakes and rivers. It can be observed that the distributions appear to be cylindrical. However the axis of the cylinders do not go through the origin in general. Therefore a cylindrical distribution model which has no restrictions as in the existing model has been proposed in this paper.

Comparisons have been made of clustering the data to spherical Gaussian models, the existing cylindrical model and the proposed model. It is shown that the proposed model gives a better fit for the data. A description of how the proposed cylindrical model can be used to segment foreground information is given.

VOLTAGE AND CURRENT SENSORS FOR 33 kV EM FIELD BASED FAULT INDICATORS

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Power failures due to different types of faults in electrical distribution systems are inevitable. As a result three phase currents and voltages deviate abnormally from nominal values. Our project was focused on this criterion to detect faults by measuring voltages and current. Fault detectors are commercially available to detect such faults. But they only sense over current. Therefore, certain types of faults such as high impedance faults cannot be detected. Apart from that they are very expensive.

Developing fault detector using both current and voltage measurements while minimizing the cost were aims of the project. First, different current measuring methods were carefully studied and a Hall Effect sensor was selected for fault current measurements. The system consists of a Hall sensor; offset adjustment, high gain amplifier, true RMS to DC converter, microprocessor and a display. It was tested successfully by supplying high current up to 400 A by a current injector. Then, a fault voltage measuring system was developed using an Aluminum parallel plate capacitor with each plate having dimensions of 5 cm × 8 cm with a gap of 1 cm between them. This system consists of exactly the same components used in the current measuring system except the Hall sensor. It was tested by supplying a high voltage up to 30 kV by a 60 kVA, 60 kV transformer. It was found that measured voltage accuracy was sufficient to manage project objectives. Further, it can be suggested that a programmable console unit adopting a fault analysis can be used with three sets of voltage and current measurements from three phases to determine any type of fault occurs in 33 kV power lines.

PRETREATMENT OF WATER HYACINTH TO IMPROVE ETHANOL AND BIOGAS PRODUCTION: A REVIEW

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Water hyacinth has been proven as a potential organic source for biogas and bio ethanol production. However, effective hydrolysis or digestion of water hyacinth is required by these applications, which is often limited by the presence of lignin in its structure. Hence, a pretreatment process is necessary to break this lignin structure and allow enzyme mediation for hydrolysis and digestion. According to the literature, physical (mechanical), chemical, physiochemical and biological pretreatment methods can enhance hydrolysis and digestion. In this study, these pretreatment methods were comparatively studied through literature survey.

Physical pretreatment can increase the porosity and the accessible surface area, and decrease the crystallinity of cellulose. Milling, irradiation, hydrothermal, high pressure steaming, expansion, extrusion, and pyrolysis are some examples.

Combination of both physical and chemical pretreatments is called as physiochemical pretreatments. Steam explosion, Ammonia fiber explosion (AFEX), CO₂ explosion and SO₂ explosion are some of them. Materials undergo reduction in high pressure and consequently high temperature (160 - 260 °C) within 2-20 min period with parallel addition of some chemical. There are many advantages such as non-toxicity, non-flammability, easy recovery, and environmental friendly but this may be too expensive for industrial applications.

Pretreatments with various chemicals have received considerable research attention over the years. Alkali, acid, gas, oxidizing agents and solvents are mostly used chemicals. Chemicals attack lignin structure and hence increase the accessible surface area for the enzyme mediation. Sulfuric acid pretreatment seems to be mostly used and convenient method in most of the water hyacinth investigations.

Enzymatic hydrolysis of biomass can also be enhanced using microorganisms. Fungi and actinomycetes are some reported microorganisms in literature. These treatments cause degradation of lignin structure, and then clear the path to the biomass hydrolysis or fermentation.

Literature revealed that these four methods have different ways of attacking the lignin and two combined methods enhance the enzyme hydrolysis and fermentation further. However, according to the type of material, pretreatment is varied.

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SIGNIFICANT EFFICIENCY GAIN IN ORGANIC SOLAR CELLS USING VERY SMALL CONCENTRATIONS OF SEMICONDUCTING SINGLE WALL CARBON NANOTUBES

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The power conversion efficiency (PCE) enhancement of donor acceptor polymer based bulk heterojunction OSCs using pristine single walled carbon nanotubes (SWNT) as an active layer additive is demonstrated using the polymer blend of PTB7/PC₇₀BM. The pristine SWNTs, added in very small quantities, are found capable of enhancing the device PCE in the presence of processing additive *N*-Methyl-2-pyrrolidone (NMP), which also acts as the SWNT dispersant. The placement of nanotubes within the active layer is random, keeping with the solution processability of the active layer. Unsorted SWNT samples containing both metallic and semiconducting nanotubes, as well as sorted SWNT samples containing only semiconducting nanotubes are used in this study to investigate, (i) whether it is possible to enhance the PCE of BHJ OSCs using pristine SWNT for the particular polymer blend employed and (ii) whether semiconducting SWNTs are better at PCE enhancement compared to unsorted SWNT, and if so to what extent.

Semiconducting SWNT are found to be far superior in performance, enhancing the PCE by 29% from 4.9% to 6.3% where fill factor improved from 54% to 61% and short circuit current density improved from 12.1 mA/cm² to 14.4 mA/cm². In comparison, the use of unsorted SWNT resulted in enhancement of 11% in PCE. Improvements by semiconducting SWNT are due to improvements in both fill factor and short circuit current density, whereas only fill factor enhancements were observed when unsorted SWNT have been used. Both types of SWNT were found to lower the open circuit voltage, but enhancements in fill factor and short circuit current density is significant enough to overcome this. The reported PCE enhancements were achieved with very small quantities of SWNT, (0.02-0.04% polymer weight) which is two orders of magnitude lower than previously reported quantities. The presented results are important in terms of PCE enhancements and also in reduction in amount of SWNT required to achieve the given PCE enhancements.

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FEASIBILITY STUDY OF PADDY-STRAW-DERIVED ACTIVATED CARBON FOR DEFLUORIDATION OF DRINKING WATER IN SRI LANKA

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In Sri Lanka high concentrations of fluoride in groundwater has been reported from the areas of North central and Eastern provinces. An excessive level of fluoride in drinking water has adverse health impacts as dental and skeletal fluorosis and chronic kidney diseases. Adsorption method is an effective technique to remove excess fluoride in drinking water, especially for developing countries due to its technical feasibility and low operating cost. In this study, paddy-straw derived activated carbon is investigated as an adsorbent, which is an agricultural waste abandoned in above mentioned areas. This adsorbent was found to be effective in some research conducted elsewhere and its feasibility for defluoridation of drinking water in Sri Lanka is explored here.

Paddy straw activated with one step steam pyrolysis at 650°C is compared with the defluoridation capacity of commercial activated carbon (CAC). Paddy straw derived activated carbons (PSAC) were further modified with KMnO₄ and HNO₃ to improve its surface functionality. A batch adsorption study with varying initial concentration, dosage and solution pH are conducted and the effect of these parameters on the fluoride removal efficiency (R%) of both PSAC and CAC is analyzed. The maximum removal efficiency of 12% and an adsorption capacity of 0.16 mg/g were reported for CAC at pH 2 while PSAC showed an insignificant fluoride removal. The results of the study suggest that both PSAC and CAC are weak adsorbents for fluoride and are not suitable for defluoridation of drinking water in Sri Lanka. With those results, the study is further directed to identify the surface functional groups and zero point charge in activated carbons which are useful in explaining the incapability of fluoride ion adsorption.

APPLICATION OF GIS TECHNIQUES TO DEVELOP INSTANTANEOUS UNIT HYDROGRAPH WITH USING CLARK'S METHOD

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Availability of a unit hydrograph for a catchment is vital in hydrological studies. However, availability of observed discharges at the basin outlet of interest with corresponding rainfalls, which are required for the development of unit hydrograph for the area, is very scarce. In such cases, unit hydrographs are developed using synthetic methods that are based on basin characteristics. In this research a synthetic unit hydrograph based on Clark's Unit Hydrograph Method was developed for a basin using digital elevation model available for the basin area.

In the development of the unit hydrograph, the basin was decomposed into individual cells. Then cell to cell flow path to the watershed outlet was determined from a digital elevation model. The time lag between cell and response at the basin outlet were found by two formulæ. The first formula depends on the curve number and the second formula depends only on the slope of the catchment.

Subsequently, time lags of the cells were used to prepare isochrones for the basin using both formulæ on which the Clark's Method depends. The areas between isochrones were then calculated, which is required for the development of the unit hydrograph. The software ArcMap version 10.2 was extensively used in the exercise.

The developed unit hydrograph was applied to model Meda-Ela watershed in Kandy using 10 m digital elevation model developed using contour map for the basin area. The Meda-Ela basin lacks observed discharge data and the Clark's Synthetic Unit Hydrograph model has time of concentration, storage coefficient and time-area histogram of the basin as its parameters. In this study the model was developed assuming all these parameters. The observed maximum discharge of the watershed and the maximum rainfall experienced in the watershed, which were available, were used for the model calibration. Out of the two formulæ used to estimate the time lag the formula, which depends on the curve number gives better results than the formula, which depends only on the slope of the catchment.

ELASTO-PLASTIC BEHAVIOUR OF PERFORATED ALUMINIUM PLATES

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Perforated aluminium plates have found use in heat exchangers, decorations, flooring and wall panels, etc. Often they are characterized by uniformly distributed hole layout on a plate of solid aluminium with uniform thickness. The shape and size of the holes as well as the hole spacing can be changed to suit the needs of a particular application. Plates with circular, square, slot and triangular shape are commercially available. The mechanical behaviours of the plates are important in various design aspects. These include allowable plane or bending stresses, limit failure modes such as buckling or rupture. Moreover, microscopic aspects in failure such as damage initiation and progress are also important. The mechanical response of the plates is bound to vary with changes in the hole size and layout.

In this study, the effect of size and spacing of circular holes on the elasto-plastic behaviour of perforated aluminium plates were investigated for equilateral triangle hole layout and square hole layout. Unit Cell based homogenization and Finite Element method was utilized for this purpose. The results were validated by a series of experiments. Unit cells for the two hole layout were identified and finite element models of the unit cells were developed with solid aluminium as the base material and appropriate periodic boundary conditions. Effective Young's moduli and yield stress of the perforated plate models were calculated under plane loading using the homogenization theory and their variation with hole size, inter-hole distance and the relative density was studied. The results of the present study were compared with existing theoretical models as well as experimental results and were found to be in agreement. This validates the computational technique employed here so that it can be utilized to efficiently investigate any material with periodic structures and will save time and material spent on physical tests.

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FILLING GAPS IN A HYDROLOGICAL TIME SERIES: A PROBABILISTIC APPROACH

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A rainfall data series plays a major role in all water related studies in areas such as hydrology, agronomy, climatology and meteorology and as an input to many hydrology related researches. Thus, having a long period record is very important to carry out a successful hydrological study. However, in general these data series contain gaps due to different circumstances, for instance: absence of observers, problems with measuring devices, loss of records and lack of funds. Objective of the study is to investigate and propose a probabilistic method available for filling gaps in rainfall data records for a river basin situated in a mountainous area in Sri Lanka. Daily rainfall data at ten gauging stations for a 10 year time period from 2004 to 2013 in upper catchment area of Badulu Oya, Sri Lanka were collected considering their data availability and spatial variability.

Generalized Gamma probability distribution was adopted in this study because of its continuity, flexibility, and the property of generating only non-negative values. It also has the ability to mimic the attributes of other distributions such as Weibull or lognormal. Usually, the daily rainfall data are highly right skewed and this distribution well matched with that. Initially, a station having 100% data availability was selected as the index station (Badarawela) and data in some months at that station covering all months in different years were randomly deleted. Then only for non-zero values, Generalized Gamma Probability distribution was fitted on monthly basis for available daily rainfall data over the ten year time period and the probability distribution parameters were estimated. It is assumed that the missing rainfall values have similar statistical properties to that of the available data record. Then only non-zero values in the missing month were randomly generated using estimated probability distribution parameters until the averages of generated values become equal to the average rainfalls estimated based on Inverse Squared Distance Method using data at neighboring rain gauging stations within a 10 km radius. Finally, the generated data were matched with the data available at a highly correlated gauging station to order them in the correct chronological order.

The data generated for the target station were compared with the actual observations based on error statistics, Standard Deviation (STD) and Root Mean Square Error (RMSE). Simple correlation coefficients (CC) were also calculated to compare generated data with observed data. These statistics estimated for the generated data showed that the data are very satisfactory. Percentage values of no rainfall days in a month and monthly rainfall values of observed and simulated data sets were very similar for most of the filled data. It is also noticed that the reliability of results highly depends on how good is the correlation coefficient between target and neighboring station. The results indicated the method as very promising in the filling of data gaps in a hydrological time series when there is a good correlation in the rainfall pattern between index station and selected neighboring gauging station.

DEVELOPMENT OF A GUI COMBINED DATABASE FOR RESERVOIRS

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Databases are large collections of data collected and added to be used for quick search of data and data retrieval. The combination of a graphical user interface (GUI) to a database makes it more user friendly. In case of reservoir management, there are vast amount of data, those can be categorized into different sub-groups. They are; hydrological data, meteorological data, water quality data, water demand data and operational data, etc. This paper presents a GUI combined database system developed using MATHLAB software that can be used to handle a huge volume of data of a reservoir. The GUIs allow the user to insert data and view data in both tabular and graphical formats. Meteorological and hydrological data are observed daily and can be entered via relevant GUIs. Moreover, observed water quality records of different parameters measured at different depths in pre-specified different locations of the reservoir could be entered into the developed database. The system has been developed to facilitate analysis of past water quality observations by comparing with average values on location basis and depth basis. Further, past meteorological records can be analyzed on monthly basis. The database provides the facility to enter data to EXCEL work-sheets enabling further detailed analysis. The application of the developed database was demonstrated using data pertaining to Kotmale Reservoir in Mahaweli Water Resources Management System.

THE EFFECT OF COUPLING AGENT AND MIXING METHODS ON PROPERTIES OF NATURAL RUBBER AND LOW DENSITY POLYETHYLENE BLENDS

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Coupling agents are molecular bridges at the interface between two substrates, an inorganic filler and organic polymer matrix. When incorporated into polymer systems, they often promote adhesion, improve dispersion, improve impact strength and thus reduce embrittlement. The practical utility of a polymer blend is determined by the compatibility of component polymers, which is considered as the fundamental property. It has been observed that majority of rubber-thermoplastic blends, including natural rubber (NR) and low density polyethylene (LDPE) blends are incompatible thus producing inferior properties. The main objective of this study is to investigate the effects of coupling agent and mixing methods on NR and LDPE blends composites in terms of their physico-mechanical, chemical properties and phase morphology of blends.

50/50 NR/LDPE filled CaCO₃ composites were prepared by using internal mixer (brabender) at 150 °C and 60rpm for 14 minutes. Coupling agent was incorporated into polymer matrix by three mixing routes by using brabender. In mixing I, coupling agent was added after mixing LDPE and NR. In mixing II, coupling agent was added after mixing LDPE, NR and activators. In mixing III coupling agent was added after mixing LDPE, NR, activators and CaCO₃. The mixture without coupling agent composite was considered as the control. Properties of prepared composites were studied. Physico-mechanical properties were determined according to ISO standards. Composites were characterized using FTIR and morphological analyses of tensile fracture surfaces. Water absorption and gel content in p-xylene of the composites were investigated. Morphology of the tensile fracture surface of blends was observed using a transmitted light microscopy. Mixing III composite exhibited the highest tensile strength, tear strength, elongation at break percentage and gel content. FTIR spectrum peak of mixing III showed sharp peak compared to control. It also showed good water resistivity, fine phase morphology and good filler dispersion among the NR and LDPE. In overall, mixing 3 composite showed highest physical, chemical and morphological performance than the other mixing methods and control.

LOW COST ANTENNA RANGING SYSTEM

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The explosive growth in today's wireless applications has increased the demand for high performance compact antennas. Some devices require multiband or broadband antennas while some may require high gain antennas with nulls steered in specific directions. In order to verify that the designed antennas have the required properties, they have to be precisely tested in an antenna ranging system. Typically such a system consists of the source antenna, test antenna, antenna positioner, receiver, pattern recorder and the control system. Commercially used antenna measurement systems are highly expensive and in order to overcome this barrier a low cost antenna ranging measurement system is proposed.

The proposed system consists of an azimuth turn table, spectrum analyzer, signal generator, characterized wide band antenna as transmitting antenna, GPIB cable and computer equipped with NI-GPIB interface hardware and MATLAB software. The spectrum analyzer is interfaced with the computer using the GPIB protocol based program developed on the MATLAB platform. This program allows setting the initial settings of spectrum analyzer and setting up parameters for data acquisition process, and controlling the operation of the rotating table. The test signal with desired power level and frequency is generated using the signal generator and fed into the transmitting antenna. The transmitted wave is received by the test antenna which is mounted on the azimuth turn table. In order to make far-field measurements, the receiving antenna is placed at a distance greater than D^2/λ where D is the maximum dimension of the test antenna and λ is the wavelength. The frequency and the corresponding power content of the received wave were analyzed using the spectrum analyzer. The frequency and the power level are read out and stored in the computer through GPIB interface. The above process was repeated while turning the test antenna over 360 degrees by predetermined steps. Using the data acquired, the polar plot of radiation pattern is generated.

The turn table is the platform for mounting and rotating the test antenna. It is a very expensive and critical component in an antenna ranging system. Its angular resolution and accuracy is the key to a successful ranging system. In the proposed system, the turn table is connected to a DC stepper motor which has a step size of 1.8 degree. Its driver circuit is designed using the L298 bridge driver. The control unit which provides the required phase sequence with right timing for the driver circuit is designed using the IC L297 and the micro controller (16f877A). The operation of the micro controller is accessed through the program in order to synchronize the data acquisition process and table rotation.

The assembled ranging system has been successfully used to obtain radiation patterns of the test antennas in azimuth plane. This system can be further developed by decreasing the angular step size and incorporating the elevation plane movements as well in the turn table.

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CAUSES OF DELAYS IN SRI LANKAN BUILDING CONSTRUCTION PROJECTS

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It is widely accepted that a project is successful when it is finished on time. But, a large number of projects fail to meet their original contract time in Sri Lankan building construction industry. Delay in the completion of a construction project can be a major problem for contractors, consultants as well as for clients. These delays lead to costly disputes and adverse relationships amongst project participants. Therefore a comprehensive survey was carried out to identify the critical factors that cause the delays in Sri Lankan building construction projects. Through a literature survey, 52 causes of delay were identified. Questionnaire survey was carried out among 58 selected building construction projects in Sri Lanka. All the causes of delay were ranked by calculating their Relative Importance Index. The findings show that the delay in building construction projects in Sri Lanka is mostly originated by labour, followed by contractor and material, while consultant and external related causes are less important. This paper also explores and provides some recommendations to reduce the impact of delays on building construction projects in Sri Lanka.

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KINETIC STUDY FOR PHOTOCATALYTIC DEGRADATION OF AMARANTH BY NOVEL N-DOPED ZrO₂

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Heterogeneous photocatalysis using metal oxide catalysts is a promising method for the treatment of wastewater containing toxic and recalcitrant pollutants since it offers clean and solar-driven process for pollutant degradation. In this research, N-doped ZrO₂ (N-ZrO₂) catalyst is successfully synthesized by a simple thermal decomposition method. The photocatalytic activity of the N-doped ZrO₂ is evaluated by analysing the degradation of amaranth (AM), a recalcitrant dye, under visible and UVC light. The enhancement of photocatalytic activity is attributed to the narrowed band gap, increased specific surface area, and reduced crystalline size. The AM degradation efficiency under UVC light is higher than that under visible light since the maximum light absorption of the catalyst is still in the UVC region. The photocatalytic degradation of AM by N-ZrO₂ follows the pseudo first-order according to Langmuir-Hinshelwood (L-H) model. The L-H model applicability is confirmed by the linear plot obtained by plotting the reciprocal of the rate constant ($1/k$) against the initial AM concentration (C_0). In all cases, the adsorption coefficient of AM (K_{LH}) is lower than the reaction rate constant (k), pointing out that the adsorption of AM on the catalyst surface is the controlling step. Thus, the specific surface area and the availability of surface functional groups would play a pivotal role in the photocatalytic process efficiency. The K_{LH} and k at pH 7 with N-ZrO₂ concentration of 1 g/L and visible light irradiation of 16.5 W/m² are 0.05 L/mg and 2.27 mg/L h, respectively. Using UVC light of 3.5 W/m² under identical experimental conditions, the K_{LH} and k are observed to be 0.25 L/mg and 5.66 mg/L h, respectively.

POSSIBILITY OF BIOGAS GENERATION USING INVASIVE PLANT WATER HYACINTH

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Water hyacinth (WH) is an introduced pest plant, which is found in problematic quantities in natural waterways and storages. It entered Sri Lanka in 1904 and spreaded rapidly all over the country carpeting most of the water reservoirs. It has a broad spectrum of habitats. Controlling the spread of this weed is a huge challenge.

However, this invasive plant is recognized as nitrogen rich and therefore, this can be identified as a potential source of substrate to produce biogas, which is an eco-friendly biofuel. But, lignocellulosic structure of WH inhibits the bio conversion and thereby it makes the process complex. So, it requires technological skills and investments to study the feasibility of bio gas generation from abundant weed, WH. This preliminary study is to understand the possibility of generation of biogas from WH. Required substrate properties and system operational conditions were investigated while going through the literature.

Literature reveals that there are four different phases: hydrolysis, acidogenesis, acetogenesis and methanogenesis in a microbial process and proper substrate properties and system operational conditions lead to high bio gas generation. It has been found that proper C/N ratio of substrate for biogas generation lie between 16-25 and the selected WH has its ratio around 20-25. So, it is identified as a sound substrate and leaves and stems are identified as the best out of the plant. The literature reveals that particle size of the substrate effects the biogas generation and the specific methane yield is high with a small particle size (0.6-1.2 mm).

It is understood that hydrolysis of complex polymeric substrate limits the rate of digestion. Therefore, it is stressed in most of the research works that WH to be pre-treated through physical, chemical or biological pretreatment methods. But still, there is less information for pre treatment of substrate in methane production comparing to bio ethanol production. WH alone leads an inefficient biogas generation and co-digestion with other cellulosic substrate such as poultry litter, cow dung and waste sludge can be recommended. The system operational conditions pH, temperature, total solids (TS), hydraulic retention time (HRT) were found as 6.7-7.5, 25-35°C, 7-9% and 10-15 days, respectively.

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THERMAL DECOMPOSITION OF ASBESTOS-CEMENT COMPOSITES

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Due to its great tensile strength, significant resistance to heat, fire and chemicals, asbestos has been mined and widely used throughout the world in construction, automotive, and other industries. Recent studies have suggested that asbestos are used in more than 300 commercial products in different industries. However, asbestos has been classified as a known human carcinogen by International Agency of Research on Cancer (IARC) and more than 100,000 people die due to asbestos related diseases. Therefore, the use of asbestos was banned in many developed countries.

The rapid development in the areas of construction in Sri Lanka has led to the wide use of asbestos related products and still it is not banned in Sri Lanka despite some health issues. Therefore, elimination of asbestos, probably after usage from the environment is essential. Thus, development of a simple method to decompose asbestos is essential to destroy the initial fiber nature of the asbestos.

In this study, thermal decomposition method was used to destroy the hazardous nature of selected commercially available asbestos samples in Sri Lanka. Initially the composition of the asbestos samples was studied using XRD results and the study revealed that the selected samples contain Chrysotile and Amphibole type of asbestos. Scanning Electron Microscopic (SEM) and optical microscopic studies show the fiber nature of the asbestos in the selected samples. Infrared (IR) Spectroscopic studies show the presence of Silicate, Carbonate anions and hydroxyl group in the commercially available asbestos samples.

The structural and phase transformation of selected samples were studied after heat treatment (ca 700-1000 °C) under different conditions. IR, SEM, XRD and thermal gravimetric analysis confirmed that commercially available asbestos-cement composite in Sri Lanka and Japan can be decomposed by simple heat treatment process and mineral and fiber nature of the asbestos can be changed by dehydroxylation and/or decomposition process of the asbestos. In addition, the decomposition mechanism will be discussed using experimental evidence in this presentation.

FOIL ASSISTED PLANING CATAMARAN HULL FOR HYDRO BIKE

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There are various water crafts available for water based transportation, and still there exists a need for a craft designed for economical single person transportation. Even though there are several products available in the market addressing the given issue, those products are not systematically designed and developed.

Therefore, a hydro-bike, electrically driven water craft with a catamaran hull design and with the assistance of hydrofoils was designed and developed to address this issue.

Tank test data available for the standard hard chine catamaran hull series was used as the basis to design a new catamaran hull. The new hull was designed to achieve adequate stability during riding, minimize resistance on the hull body and to overcome the resistance of waves. The planning effect of the two hulls is further supported by a fully submerged hydrofoil. As the speed rises, the lift generated by the hydrofoil will cause the hulls to float on top of the water plane.

The design of the hull shape was validated using computational fluid dynamics, (CFD) for minimum resistance and maximum lift at various hull speeds. Similarly, the effect of the hydrofoil on the total drag and lift of the hydro bike was validated using CFD tools. The total power requirement for propulsion was determined by the results obtained from both the CFD analysis and from calculations using Savitsky method. A pod type electric thruster was selected to match the overall power requirements. The weight distribution of the craft with human, pod thruster and battery was adjusted to obtain an efficient initial trim angle to achieve the planning effect sooner.

The CFD analysis suggests that while the lift-to-drag ratio of the hydro bike is minor at slow speeds, it increases with the increment of speed. The hydrofoil has influenced this significance of the lift-to-drag ratio

From the obtained CFD data, we can conclude that, the planning hull used for a hydro bike together with hydrofoils is a successful design where the required power can be minimized with the addition of hydrofoil at higher speeds.

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PERFORMANCE OF ‘PENDULOR’ AND POINT ABSORBER WAVE ENERGY CONVERTERS FOR ONSHORE AND OFFSHORE APPLICATIONS IN SRI LANKA

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Depending on the need and the availability of a location at the sea, site specific wave energy devices should be selected and they are normally categorised as onshore, near-shore and offshore. Point absorber and flap type wave energy converters are well known for offshore and onshore/near-shore wave energy applications, respectively. This paper discusses the basic performances of ‘Pendulor’ device and point absorber device of similar size (10 m width) in onshore and offshore applications in Sri Lankan wave climatic conditions. The ‘Pendulor’ device is popularly recognized as a top hinged flap, placed inside a straight caisson driven by standing waves generated in the caisson. The point absorber mainly consists of floating object (hemispherical shape in this analysis) attached to a power conversion module, which enhances the oscillatory motion of the float. Characteristics of both wave energy converters were analyzed in frequency domain for regular waves and time domain for real sea waves. Frequency domain is modeled with a linear power extraction system (viscous friction). In real practice, the power takeoff system (PTO) is nonlinear and the sea state is irregular. Therefore, the time domain analysis was used to solve the equation of motion by the methodology adopted by Cummins in solving the marine body dynamical problems. The convolution term in the Cummins equation (an integro-differential equation) was approximated to State Space model. These time domain models were then simulated with single degree of freedom in a standard simulation environment Matlab/Simulink. The Pendulor device was initially tuned to give their maximum performances at significant wave period of 12 s and significant wave height 1 m. Due to the physical limitation of point absorber device (inherent problem of point absorbers), its natural frequency was set at 8.5 s. The power absorption characteristics with different wave frequencies (periods) are discussed and it is revealed that the Pendulor device shows broader bandwidth. In contrary to that, the point absorber captures high amount of energy at narrow bandwidth that is inherent characteristics of such devices. The power absorption of point absorber devices could be improved for broader frequency range by introducing load control strategies. The Pendulor device shows much better average power absorption performance without adopting any control system.

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MODELING OF A DRIVING MECHANISM FOR A SPHERICAL ROBOT

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Spherical robot design is an emerging research field that has attracted significant interest from academia and industry. A spherical robot consists of a shell and an inner driving mechanism. The pendulum based method and reaction wheel method are two popular driving mechanisms proposed in the existing literature. One common limitation in all methods is the difficulty of achieving holonomic nature.

A novel approach is proposed to overcome some of these difficulties. In the design, an arrangement using four pendulums has been implemented as the driving mechanism. These pendulums are located in a great circle of the spherical robot. Since, pendulums are free to rotate 360°, the robot is omni directional and holonomic. In order to characterize the nonlinear dynamics of the robot, a generic mathematical model applicable for an arbitrary coordinate system was derived. For simulations and controller implementation, Euler-Lagrangian method was used. Moreover, a nonlinear proportional and derivative controller was used for trajectory planning.

A prototype has been implemented using a hollow fiber sphere and Lead pendulums. Gyroscopes, accelerometers and encoders have been used to measure the rotation angles and rotational speeds of the robot. With our current design, a maximum linear velocity of 0.35m/s and a maximum acceleration of 0.01m/s² are achievable. The presented spherical robot design with future enhancements is well suited for deployments in various industrial, surveillance, military and space exploration applications.

Not Presented

UTILIZING RICE HUSK AS AN ADSORBENT FOR REMOVING DYES FROM WASTEWATER

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In today's industrial world, dyes are used extensively in many applications such as paper, textile, cosmetic, plastic and food, etc. However, significant portion of these dyes are released into natural water bodies with the effluents of above mentioned industries and contaminate the portable water. Moreover, due to undesirable characteristics such as toxicity and water pollution, it is important to remove these from effluents by any means. Hence, currently many industries employ expensive methods to control this situation. To overcome this problem, utilizing an agricultural waste as an adsorbent for removing dyes from waste water is an ideal solution. This study was carried out for verifying the potential use of rice husk to remove Methylene Blue from aqueous solutions.

Rice husk was obtained from a small scale rice mill, in Nattandiya. These were first washed with distilled water and then oven-dried at 28^oC until a constant weight is obtained. Then dried materials were sieved and particle sizes in between 0.5 mm and 2.0 mm were separated and stored in an air tight container for using in the experiment.

Before conducting the experiments, the calibration curve for Methylene Blue was prepared by using the UV spectrophotometer. First the wavelength corresponding to the maximum absorbance was determined using Methylene Blue solution with concentration of 100 mg/l. Then the absorbencies of solutions of 6 selected concentrations within the range of 1 mg/l to 10 mg/l were measured at the determined wavelength above and the calibration curve was drawn using the observations.

The batch isotherm studies were performed by varying the initial concentration of Methylene blue from 20 mg/l to 200 mg/l, which was prepared by diluting 1000 mg/l solution, while other parameters remain constant. The experimental data were fitted with Linear, Langmuir, Freundlich and Tempkin isotherms. The best fitting was judged by its correlation coefficient (R^2). The results show that the best fitting isotherms for this study is Freundlich with a coefficient of determination value of 0.971. Accordingly, the quantity of dye adsorbed by the adsorbent for unit equilibrium concentration was 3.01 l/g and corresponding heterogeneity factor was 0.353. Ultimately, the study shows that the rice husk can be utilized as a low cost adsorbent for removing of dyes from industrial effluents.

EFFECT OF THREE DIFFERENT PACKAGING MATERIALS ON COLOUR AND MOISTURE CONTENT OF DEHYDRATED GARLIC POWDER DURING STORAGE

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Garlic (*Allium sativum* L.) is a compound bulb, which comprises small bulbs called cloves, enclosed within a white membranous outer casing. It is categorized under semi-perishable spices. Hanging in mesh bags, freezing, storing in vinegar or oil and drying are the methods used to extend shelf life of fresh produce. However, moisture loss due to respiration during storage and transportation and microbial spoilage are the major causes, which limit shelf life of fresh garlic. Difficulties of garlic storage in fresh form have generated an interest in the development of dehydrated garlic products such as cloves, granulates, powder, and flakes. Garlic powder is cream to white in colour with a strongly persistent and characteristic odour and flavor when rehydrated. Food packaging has a role to retard product deterioration, retain the beneficial effects of processing, extend shelf-life and maintain or increase the quality and safety of food. This study was conducted to identify packaging material that can be used in long term storage of garlic powder and to evaluate the changes in moisture absorption and colour deterioration in each packaging tested. Garlic bulbs free of damages and diseases were purchased from the local market and transported to food processing laboratory of Institute of Postharvest Technology (IPHT) in Anuradhapura, Sri Lanka. The bulbs were declodded and peeled manually, sliced into 5 mm thickness using stainless steel knife and put into water while slicing. Then slices were drained and soaked in aqueous solution of 0.1% sodium metabisulphite for 2 min, dried in an electrical oven for 2 h at $60 \pm 1^\circ\text{C}$ followed by continuous drying at $55 \pm 1^\circ\text{C}$ until slices got $7 \pm 1\%$ moisture content. Dried slices were powdered using a laboratory scale grinder, sieved and packaged in 10×15 cm size bags of three different packaging materials; Polypropylene (PP), Biaxially oriented polypropylene/Cast Polypropylene (BOPP/CPP; Laminates) and Low density polyethylene/Metalized polyethylene terephthalate (LDPE/MPET; Metallized film) containing 100 g of garlic powder and sealed using plastic film sealer (Brother PCS 200/300). Samples were kept at room temperature ($30 \pm 2^\circ\text{C}$, $60 \pm 5\%$ RH) for six months. Changes in moisture content and colour were measured at one month interval. The experiment was laid out in a complete randomized design and each treatment consisted of triplicate. Data were analyzed by Analysis of Variance (ANOVA) using Statistical Analysis System (SAS) for windows version 9.0. Differences between treatment means were obtained by Duncan's multiple range test at 5% significance level ($p < 0.05$). Results revealed that increments in the moisture content of garlic powder in different packaging materials were significantly different ($P < 0.05$). Accordingly, PP material has absorbed highest moisture of 5.26 % and lowest 0.86% was recorded from LDPE/MPET while BOPP/CPP had 3.61% at the end of the storage period. Garlic powder packaged in all packaging materials had shown reduction in Lightness value (L^*) value during storage. However, L^* value of MPET was significantly higher ($P = 0.0036$) at the end of the storage. Thus, MPET material can be recommended for six month storage of garlic powder that has lowest colour change and moisture increment. BOPP/CPP (Laminated material) can be recommended for short term storage up to 3 months. However, PP is not suitable as a packaging material for storage of garlic powder. Further, studies are needed to evaluate methods to minimize the colour changes of the Garlic powder.

IMPROVEMENT OF STORAGE STABILITY AND QUALITY OF COCONUT (*COCOS NUCIFERA*) MILK

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Coconut milk is natural oil in water emulsion. Layer separation in processed coconut milk during storage leads to reduced stability and quality of products. The demand for such products is generally low and unsatisfactory. Therefore, addition of emulsifiers and stabilizers is considered as a requirement in commercial processing of coconut milk. The objective was to determine the best stabilizers and emulsifiers to prevent layer separation of coconut milk. The relationship between mixing temperature and quantity of stabilizers with functionality of stabilizer were investigated.

Mixing temperature and quantity of stabilizers were altered to take 9 treatment combinations. Creaming index, viscosity and optical microscopic photographs were measured at each treatment combinations. Sensory evaluation was done to determine the effect of stabilizer for sensory properties of coconut milk.

Combination of Xanthan gum and Guar gum, 3:2 ratio was selected as the best stabilizer combination that reduced layer separation of coconut milk. There were significant differences ($P < 0.05$) in creaming index and viscosity in treatment combinations with respect to temperature, quantity of stabilizer and their interaction. The lowest value of creaming index and highest value of viscosity was obtained at 0.5 % w/w and 80°C combinations. From the ranking test, determine the best quantity of stabilizer that retained the organoleptic characters. There were significant differences ($P < 0.05$) among treatments based on taste, appearance, texture and overall acceptability. Treatment with 0.3 % w/w stabilizer scored the least rank except for taste. Thus, it was statistically considered as the most preferred sample. From the Hedonic test, there were significant differences ($P < 0.05$) between coconut milk with stabilizer and coconut milk without stabilizer in terms of appearance except taste.

It can be concluded that 0.3 % w/w stabilizer and 80°C were the most suitable quantity and mixing temperature combination to reduce layer separation of coconut milk emulsion while retaining the sensory properties of coconut milk. Application of Xanthan gum and Guar gum mixture was cost effective and maintained the stability of coconut milk. Therefore, combination of Xanthan gum and Guar gum can be recommended as the most appropriate combination. The synergistic interactions of Xanthan gum and Guar gum have been reported using intermolecular binding and physical models.

PATTERN OF BREAKFAST CONSUMPTION AMONG ADVANCED LEVEL FEMALE STUDENTS IN A SELECTED SCHOOL IN COLOMBO DISTRICT

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Breakfast (Bf) is an essential meal for adolescents for their physical and mental well being. It is more important for female students with child bearing potential, who require adequate energy deposition for pregnancy as Bf provides significant proportion of daily energy intake. Bf is the most frequently missed meal by Sri Lankan school children. Regular Bf consumption during adolescence significantly predicts young adults' regular Bf consumption. To date, no published data are available on pattern of Bf consumption and associated socio-demographic and economic factors of Sri Lankan advanced level female students. A descriptive cross sectional study was carried out on 120 randomly selected advanced level female students in a selected school in Colombo district. A self-administered questionnaire was used to collect data on socio-demographic characteristics, pattern of Bf consumption and reasons for various food habits.

Majority of students were from Colombo district (79.2%) and there were equal number of students (30) from all four advanced level streams (Bio-science, Mathematics, Commerce and Arts). Majority (56.7%) consumed Bf daily. Considerable percentage (40%) was irregular Bf consumers and remaining minority did not consume Bf at all. Commonest choice at Bf was rice (51.7%). Majority (77.5%) never consumed cereals as Bf whereas considerable percentage (40.83%) consumed bread as Bf for less than three days per week. Most common (32.8%) time of Bf was between 6.00-7.00 a.m. while nearly equal percentage (32%) consumed Bf after 10.00 a.m. Home was the place of provision of Bf in majority (53.4%). Main reason for Bf skipping was lack of time (65.4%), which was mainly due to transport difficulties (64.7%) and waking up late (47.1%). However, considerable percentages of students skipped Bf due to lack of motivation (21.15%) and busy schedule of the mother (13.46%). District of residence, stream of study, mother's employment status and family income were not significantly associated with frequency of Bf consumption. The education level of mother was significantly associated with student Bf consumption ($p < 0.05$). Students with mothers educated up to advanced level were more likely to be regular Bf consumers. When mothers were educated only up to ordinary level and also when mothers have attained higher education students were less likely to consume Bf regularly. Majority of students consumed Bf regularly if their parents were regular Bf consumers and student Bf consumption was significantly associated with parents' Bf consumption ($p < 0.05$). When parents consumed home-made Bf, students were more likely to consume home-made Bf ($p < 0.05$).

Since majority of the students skipped Bf due to lack of time and lack of motivation, students should be taught about prioritizing the available time and the importance of Bf. As mother's educational level, Bf consumption and place of provision of Bf were significantly associated with the pattern of students' Bf consumption, community interventions are recommended to improve the knowledge and attitude about importance of Bf among mothers. Further studies are needed using large samples and assessing other associated factors.

INVESTIGATING THE CAPABILITY OF SELECTED LEGUME PROTEINS TO FORM NANO-SCALE PARTICLES WITH CARRAGEENAN

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Biopolymer particles at nano-scale can be formed by controlled electrostatic interactions between proteins and ionic polysaccharides. The aim of this study was to fabricate biopolymer particles by interacting proteins extracted from two legume varieties, namely, mung bean (*Vigna radiata* var. MI-6) and cowpea (*Vigna unguiculata* var. MI-35) with a seaweed polysaccharide, carrageenan. Extraction and purification of proteins from legume seeds were done *in situ*, and the final legume protein isolates (LPIs) had a protein content of $\geq 83\%$ w/w. *Sodium dodecyl sulfate polyacrylamide gel electrophoresis* (SDS-PAGE; 12% resolving gel) showed that vicillins are abundant in both LPIs. These LPIs were interacted with carrageenan at a concentration ratio of 2:1, at pH 6 and pH 6.5. These pH values were selected to provide an adequate, yet not an excessive electrostatic potential in order to facilitate their assembly into nano-scale particles. Stability of the particles formed in the mixtures was higher at latter the pH. Scanning electron microscopy (SEM) showed that the particles formed are roughly spheroid in shape, and the average diameter of the particles made with mung bean and cowpea protein isolates was ~ 120 nm and ~ 140 nm, respectively at pH 6.5 ($n = 50$). Heating the mixtures containing these particles above the denaturation temperature of proteins (85°C) increased their stability against aggregation over a pH range of 4–7. However, SEM images showed that heat treatment led to an increase in the diameter of the particles, and it was attributed to the unfolding of proteins within the particles. These biopolymer particles can be potentially used for the encapsulation and delivery of bioactive compounds, or as a substitute for lipid droplets.

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A PILOT STUDY ON BIOETHANOL PRODUCTION FROM ROTTEN CUCUMBER (*CUCUMIS SATIVUS*)

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Production of bio-ethanol to meet the global demand has led to the search for non-conventional raw materials, since the conventional crops such as corn, starch, agricultural wastes, etc., cannot meet the heavy demand. Rotten fruits and vegetables have been postulated as good candidates in this regard. In Sri Lanka, during harvest time, large quantities of easily perishable vegetables including cucumber go waste, mainly due to surplus production in comparison to the need. Therefore, converting them to a marketable commodity would be of immense economic importance to the agriculture industry. The objective of this study was to test the potential for producing bioethanol using rotten cucumber (*Cucumis sativus*) as the raw material.

Rotten cucumber without seed (50 g), was ground with 100 ml phosphate buffer, pH 7.4. The 'test' fermentation was prepared by adding 100 ml of 1% starch and baker's yeast (1g) to 25 ml of the cucumber solution. It was then allowed to ferment at 25-30°C under anaerobic conditions. The 'control' sample was prepared by adding 100 ml of 1% starch, 25 ml of distilled water and baker's yeast (1 g) without cucumber preparation. The fermentation was carried out for two weeks and aliquots taken after one week and two weeks of fermentation were analysed for ethanol production, by using redox titration. The titration involved acid dichromate, potassium iodide and sodium thiosulfate.

The alcohol yields at the end of 1st week and 2nd week in the test fermentation, over and above the control fermentation, were 594 µmol (27 mg) and 918 µmol (42 mg). Since these quantities were produced from only 12.5 g of cucumber, the net production at the end of two weeks was 3.4 g per 1 kg of cucumber.

By using a high ethanol producing yeast culture and optimizing the conditions one should be able to obtain a higher yield of ethanol. Such a production system could probably incorporate other perishable vegetables and fruits such as kekiri, tomatoes, papaya, melon etc. This study confirms that bio-ethanol could be produced by using rotten cucumber.

EFFECT OF PROCESSING METHOD ON PHYSICAL AND SENSORY CHARACTERISTICS OF SOY (*GLYCINE MAX*) MILK

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Soy milk when compared to cow milk provides less saturated fat. It also does not contain cholesterol, lactose or gluten. However, one of the limiting factors is the undesirable beany flavor. Therefore, the present study was conducted to identify an appropriate process for soy milk production to attain the composition stipulated by soy milk standards.

Soy milk was prepared following four different methods (M1, M2, M3, & M4). In M1 beans were soaked overnight with tap water and in M2 and M3, beans were soaked with 0.5% NaHCO₃. In M4, soaking of beans was not practiced. The milk slurry was obtained in M1, M2 and M4 by cold extraction whereas in M3 by hot extraction. Homogenization was done only for M2 soy milk. All extractions were pasteurized, filled into bottles and refrigerated. The pH was determined by using a pH meter. Percentage milk yield was estimated. Fat content was determined by Gerber method. Total solids were estimated by Richmond's formula. Solid Non Fat content was estimated by Troy's formula. Mean comparisons were done by using Duncan's Multiple Range Test. Sensory evaluation of soy milk was conducted by 18 trained taste panelists. Kruskal Wallis test was performed to calculate Mean Ranks.

Significantly higher pH values were observed in M2 and M4 (7.41, 7.36 respectively). The minimum pH of 6.88 was observed in M1. Significantly higher % milk yield was observed in M2 (69.89%), compared with M1, M3 and M4 (57.72%, 57.34%, 62.25% respectively). Significantly higher total fat contents were observed in M2 (2.65%) and M3 (2.54%). The lowest total fat content was in M1 (2.03%). Significantly higher total solid contents (9.45%, 9.57% respectively) and solid non fat contents (6.66%, 6.89% respectively) were observed in M2 and M3. Both the fat content and total solid content observed in the study for M1, M2 and M3 soy milk samples were comparable to the compositional levels (≥ 1.0 for fat, ≥ 7.0 for total solids) stipulated by conventional soy milk standards. Significant differences were not identified by the panelists ($p > 0.05$) regarding sensory characteristics such as color, flavor, texture, taste. Hence, the overall acceptability of soy milk prepared according four different methods and cow milk were same. Soy milk from M2 method scored the highest mean rank for flavor, texture and overall acceptability among all four methods tested.

The observed results suggested that soy milk extracted by M2 method, by soaking with 0.5% NaHCO₃, followed by cold extraction, homogenization and pasteurization, which showed the highest fat content and second highest solid nonfat content indicating that this could be a better process to improve the wider acceptability of soy milk.

DIETARY SUPPLEMENTATION OF DRIED *SPIRULINA PLATENSIS* ON GROWTH PERFORMANCES OF BROILER CHICKEN

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Sri Lanka has a rising demand for broiler chicken products compared to other animal products. However, the cost of broiler production is comparatively high in Sri Lanka. Although *Spirulina platensis* is one of the cost effective feed resources with high nutritive value, which can potentially be utilized in broiler feed industry, the effect of supplementing dried *Spirulina* on growth parameters in broiler chicken has not been adequately evaluated. Therefore, the present study was undertaken to determine the effects of supplementing dried *Spirulina* on growth performances of broiler chicken.

Spirulina was cultivated in tanks and harvested. They were then sundried and dried at 60°C until a constant weight was obtained and ground using a grinder to a fine consistency to obtain dried *Spirulina* powder.

Sixty male Cobb 500 day old chicks were randomly allotted into 3 treatment groups as control (commercial broiler feed), 4% dried *Spirulina* powder + commercial broiler feed and 8% dried *Spirulina* powder + commercial broiler feed. Each treatment group consisted of 4 replicates with 5 birds per replicate. Feed intake was measured daily, while body weight of each bird was measured weekly. At 35th day, all the birds were weighed and sacrificed. Finally, the carcass weights of all the birds were measured.

Both 4% and 8% *Spirulina* supplemented groups obtained significantly ($p < 0.05$) higher live weights and weight gains and significantly ($p < 0.05$) lower FCR than control group which was supported by significantly ($p < 0.05$) higher crude protein content in 4% and 8% *Spirulina* supplemented diets. In conclusion, supplementation of *Spirulina* showed advantageous in relation to growth parameters of broiler chicken.

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COMPARISON OF NUTRITIONAL AND FUNCTIONAL PROPERTIES OF RAW AND PROCESSED MUNG BEAN (*VIGNA RADIATA*)

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Mung bean is an important grain legume, which is a rich source of nutrients and other bioactive compounds with many beneficial physiological effects. However, the effect of processing on nutritional and functional properties of mung bean has not been widely studied. In the current study effect of processing (boiling and sprouting) on some nutritional and functional properties of mung bean was investigated in comparison with raw mung bean.

Mung bean seeds (*Vigna radiata*), Variety MI6 were obtained from the Government Seed Center, Dambulla which was cultivated in 2014 in Yala season and boiled and sprouted mung bean was prepared. Proximate composition, gross energy, insoluble dietary fibre (IDF) and soluble dietary fibre (SDF) contents of raw and processed mung bean were determined on dry matter basis. DPPH and ABTS assays and total phenolic content (TPC) and total flavonoid content were determined by Folin-ciocalteu and Aluminium chloride method, respectively. Antidiabetic effect was determined by α -amylase inhibitory assay and microbial fermentation characteristics were measured using unadapted microorganisms obtained from swine caecum.

Crude Protein (CP) content of boiled mung bean was significantly ($P < 0.05$) lower than that of raw mung bean while it was significantly ($P < 0.05$) higher in sprouted mung bean than raw mung bean. Further, the crude fat content (CF) was significantly ($p < 0.05$) lower in sprouted mung bean when compared to raw mung bean. IDF content in raw mung bean was significantly ($P < 0.05$) higher than that in sprouted and boiled mung bean whereas, SDF content in boiled mung bean was significantly ($P < 0.05$) higher ($P < 0.05$) than that in sprouted and raw mung bean.

The results showed that processing significantly ($P < 0.05$) reduced antioxidant activity and phenol content compared to raw mung bean. However, flavonoid could only be detected in sprouted mung bean. Further, α -amylase inhibition in raw mung bean was significantly ($P < 0.05$) higher than that in boiled mung bean.

In conclusion, processing (boiling and sprouting) influences the CP content, CF content, dietary fibre content, antioxidant capacity, α -amylase inhibition and antidiabetic effect in mung bean.

CONSUMER PREFERENCES IN PURCHASING ORGANIC FRUITS IN KELANIYA D.S DIVISION

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Attention on environmental impacts of intensive agricultural practices and health risk associated with pesticide residues has increased over the years. Excessive and careless use of agrochemicals causes damages to the environment and human health. In this context, organic farming is gaining recognition as an environmental friendly, production system. Consumers too demand food with less agrochemical residues. Fruits are consumed among all the age cohorts of people and many demand residue free organic fruits. This study examines the consumer awareness and willingness to pay (WTP) for organic fruits and the effect of socio demographic variables on the WTP in the Kelaniya DS division. An interview schedule was used for the data collection among 158 respondents using simple random sampling technique. The survey included question on demographic characteristic (age, education, gender, household size, monthly income), and attitudes and knowledge about organic products, health hazards and environmental degradation due to agrochemical application. A binary logistic regression model was constructed to identify the impact of the relevant explanatory variables on the dependent variable. The results suggested that WTP was significantly affected more likely by occupation and less likely by age, income, and family size. Marketing efforts should be focused on this target group of consumers. Results also indicated that 78% of respondent would be willing to pay prime price for organic fruits. On average, respondents were willing to pay 34% more for organic produces. This shows the market potential for organic banana, papaya and mango in this area. The finding of the study could be helpful to producers and sellers in assessing market potential for organic fruits in the Kelaniya DS division.

PROCESSED MUNG BEAN (*VIGNARADIATA L.*) INCORPORATED DIETS MODULATED SERUM LIPID AND GLUCOSE CONCENTRATIONS IN WISTAR RATS (*RATTUSNORVEGICUS*)

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Hyperlipidaemia refers to increased levels of lipids (fats) in the blood, including cholesterol and triglycerides. Although hyperlipidemia does not cause symptoms, it can significantly increase the risk of developing cardiovascular disease. CVD is the most important single cause of non-communicable disease in the world. Legumes play an important role in modulating the serum lipid and serum glucose level. This study assessed the changes in serum lipid profiles and serum glucose level of high cholesterol diet fed Wistar rats with a view to elucidate the effect of raw and processed Mung bean. Seven weeks old 20 male Wistar rats were randomly allocated into groups (n=5) and fed with experimental diets *ad-libitum* for 5 weeks. Diets were prepared according to the ANI-93G semi purified rodents diet and 0.5% cholesterol was added to obtain high cholesterol diet. 0.5% cholesterol + 30% raw mung bean (RMD), 0.5% cholesterol + 30% boiled mung bean (BMD), 0.5% cholesterol + 30% sprouted mung bean (SMD) and 0.5% cholesterol + 10.15% casein powder (CD) were given as treatments. At the end of the experiment and serum total cholesterol (TC), Low density lipoprotein (LDL) cholesterol, High density lipoprotein (HDL) cholesterol, triglycerides, glucose and insulin concentration were measured. Finally rats were sacrificed, liver and cecal weight, kidney fat index, cecal pH were measured. The data were analyzed using Complete Randomized Design. *Coliform* count in cecal content was enumerated. No significant change (P<0.05) was observed in total cholesterol levels in all treatment groups compared with the control group. Serum HDL cholesterol concentration in rats fed with SMD and BMD diets were significantly (P<0.05) higher than that in the control and Serum non-HDL cholesterol concentration in rats fed with SMD and BMD diets were significantly (P<0.05) lower than that in the CD fed group. At the same time Triglycerides levels also significantly reduced in processed mung bean fed groups than row and Triglycerides levels in all treatment groups were significantly lower than the control group. Serum glucose concentrations in rats fed RMD, BMD and SMD were significantly (P<0.05) lower than CD diet and Serum insulin concentrations in rats fed RMD, BMD were significantly (P<0.05) lower than CD diet. These results indicate that processed mung bean incorporated diets positively modulate both serum lipids and glucose levels higher than control group. Within that BMD and BSD positively modulate serum lipids than RMD, though there was no significant change in modulating serum glucose levels within mung bean fed groups.

HOUSEHOLDS' ATTITUDES ON CONSUMPTION OF GREEN LEAFY VEGETABLES IN SEMI URBAN AREAS IN COLOMBO DISTRICT, SRI LANKA

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Green leafy vegetables (GLVs) are an important component of a healthy diet, which are rich sources of many nutrients such as vitamin A, vitamin C, riboflavin, folic acid, carotene, minerals (Ca, K, Fe, and Na), and crude fibers. Though GLVs are rich in many nutrients, the consumption of GLVs is still low and it is not continuously included in daily consumed foods among the Sri Lankan households. Therefore, there is a requirement to identify reasons behind the low consumption of GLVs in household level and it is very useful to consider the present status of consumption of GLVs including needs, preferences and behaviors of the consumers. This study was carried out to understand the households' attitudes in relation to the purchasing and consumption patterns of GLVs among the households. Preliminary survey and interviews with study subjects were conducted in the Maharagama Municipal Council, Colombo District, Sri Lanka. About 121 households within the Maharagama Municipal Council were selected as sample size using simple random sampling technique. Primary data were collected through interviewer administered questionnaire and the fact relating to the purchasing and consumption patterns of GLVs were obtained

Results revealed that *C. asiatica*, *A. sessilis*, *S. grandiflora*, *I. aquatica* were the most preferred and the most consumed types of GLVs. *S. grandiflora*, *C. asiatica* are cultivated by most of the households in their home gardens. GLVs were not much popular in daily consumed foods among households in the Colombo district and the average frequency of consumption of GLVs was 3 days per week. *A. sessilis*, *S. grandiflora*, *I. aquatica* were consumed in cooked form by most of the households while *C. asiatica* was consumed in uncooked form. Most people acquired the daily need of GLVs from both market and their home gardens. Majority used to purchase GLVs from retailers and they spent LKR 201-400 for consumption of GLVs per month. According to the rank based quotient for reasons to consume GLVs, nutritional value was ranked first while price aspect was ranked last. Therefore, most people more concerned with the nutritional value than with the price when they purchased GLVs. According to the Kruskal-wallis test, there were relationship between factors called easy to process and time saving, better taste of the GLVs, cheaper price, absence of agrochemicals, GLVs are cleanliness and hygiene, health friendliness and level of preference. To reduce those factors, factor analysis was done and according to that two specific components were identified. The factor 1 was quality and the factor 2 was utility. The factor 1 dealt with cleanliness and hygiene, and health. The factor 2 dealt with easy processing and time saving, price, taste and absence of agrochemicals. Majority of the respondents (61%) were aware of the packaged GLVs which were available in the supermarkets and most of them (79%) did not prefer to purchase such packaged GLVs. Because of the freshness and hygienic conditions of those packaged GLVs, those who preferred to purchase packaged GLVs, were willing to pay extra LKR 50-60. Further, it can be suggested people value the nutritional level and the quality of GLVs more than the price.

MORPHOLOGICAL AND MORPHOMETRIC ANALYSIS OF INDIGENOUS GOATS FOUND IN EASTERN REGION OF SRI LANKA

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Indigenous goat in Sri Lanka is a valuable genetic resource that is threatened with considerable genetic erosion mainly due to crossbreeding. The present study was conducted to evaluate morphological and morphometric parameters of indigenous goats dwelling in Eastern region of the Sri Lanka. The study locations selected belong to Kiran and Vahari veterinary divisions in Batticaloa district.

A total of 186 adult goats were used to collect data in relation to breed characteristics. The farming system information was collected using a pre-tested structured questionnaire from 35 households who keep only indigenous animals. The data were presented using descriptive parameters, Pearson's correlation and principle component analysis in *MINITAB* (version 14).

Indigenous goats farming system in the eastern region could be characterized as an extensive rearing system with predominant (> 95%) herded grazing and occasional (23%) night supplementation. External inputs were minimum including labour. Animals were kept in medium size flocks (32 heads) for the purpose of animal sale. Breeding materials were generated within the farm and natural breeding was practiced where six months kidding interval is generally could be seen. Indigenous animals were small in size, predominantly (98.9%) having angular bodies with black and white coat colour. Fourteen different morphometric measurements were used to describe male and female indigenous goat populations. Among morphological features, distinguishable horizontal line on the back of the body and on both sides of face, and low occurrence of toggles (12%) are the highlighting characteristics. Pearson's correlation coefficient analysis of morphometric measurements revealed a significant ($P < 0.01$) correlation between body weight (BW) and thirteen other body measurements. Principle component analysis indicated that BW, heart girth (HG) and body length from neck to hip (BL) are the morphometric measurements that mainly contribute to the variation among the goats in the population. Accordingly, the relationship between BW, HG and BL could be explained by the expression $BW = 0.221 HG + 0.130 BL - 4.22$ ($R^2 = 0.355$), which could be used to predict body weight from heart girth and body length with a considerable accuracy. The study further revealed that indiscriminate crossbreeding is the main reason that causes fast genetic erosion of the valuable indigenous goat genetic resource in the area.

It could be concluded that the indigenous goat populations in *Kiran* and *Vahari* veterinary divisions have been conserved through utilization as well as by geographical isolation. Animals are small in size and exhibit distinguishable morphology with considerable diversity.

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A COMPARATIVE STUDY ON DIETARY FIBER, ANTIOXIDANT CONSTITUENTS AND FUNCTIONAL PROPERTIES OF *ELEUSINE CORACANA* (FINGER MILLET) AND *ORYZA STIVA* (RICE)

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Cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are the major non-communicable diseases (NCD) which cause 63% of global deaths annually. It is well known that nutrition plays a vital role in the physical and mental wellbeing of human. While providing the basic nutrients, some foods exhibit beneficial health related functional properties. Many studies have proven that cereals are important sources of dietary fiber, minerals and phytochemicals. Rice is the staple food in most Asian countries while finger millet is widely consumed by poor communities in Asia and Africa. Moreover, finger millet has been known as a therapeutic food since ancient times for diabetes. Also it has a greater sustaining power and satiety scores. Therefore, the purpose of this study was to determine the therapeutic effect of finger millet (FM) compared to rice, to encourage its future applications as a functional food.

To investigate this, dietary fiber content, antioxidant activity, alpha amylase inhibitory activity and fermentation ability of Rawana and Oshada FM varieties were measured against Basmati and BG-300 rice varieties under *in vitro* conditions.

The results showed that both soluble and insoluble dietary fiber (DF) contents were higher ($P < 0.05$) in Rawana and Oshada than Basmati and BG-300. Moreover, soluble and insoluble DF contents of Oshada ($0.44 \pm 0.04\%$ and $11.62 \pm 0.35\%$, respectively) were higher ($P < 0.05$) than Rawana ($0.38 \pm 0.02\%$ and $10.67 \pm 0.19\%$, respectively). Total flavonoid content (TFC) of Rawana was similar to Basmati and BG-300. However, Oshada had the highest TFC (1.05 ± 0.08 Catechin equivalent mg/g). Total phenolic contents (TPC) of both FM varieties were higher ($P < 0.05$) than both rice varieties. Oshada had a higher ($P < 0.05$) TPC than Rawana (8.08 ± 0.17 and 6.40 ± 0.09 Gallic acid equivalent mg/g, respectively). Both FM varieties showed a higher ($P < 0.05$) 2, 2-diphenyl-1-picrylhydrazyl (DPPH) scavenging activity than BG-300 and Basmati. Similarly, 2, 2'-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid (ABTS) scavenging activity was higher ($P < 0.05$) in both FM varieties than Basmati and BG-300. Furthermore, ABTS scavenging activity was higher ($P < 0.05$) in Oshada than Rawana. Alpha amylase inhibitory activity of Rawana and Oshada were higher ($P < 0.05$) than Basmati and BG-300. However, the IC_{50} values of both FM varieties were greater ($P < 0.05$) than acarbose which is a drug used to treat type II diabetes. The results of the microbial fermentation study revealed that Rawana and Oshada produced a higher amount of hydrogen and carbon dioxide than rice varieties during the incubation at 39°C with un-adapted caecal microflora.

Therefore, these results indicate that both FM varieties, particularly Oshada variety has more beneficial nutritional and health related protective properties than Basmati and BG-300 rice varieties *in vitro*.

FACTORS AFFECTING THE VEGETABLE PRODUCTION IN BALANGODA DIVISIONAL SECTRTARIAT

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Approximately 3% of Sri Lankan Gross Domestic Production is resulted by “other food crops” category which includes vegetables as a significant contributor. Vegetables are produced in larger quantities throughout the year by island widely distributed farmers. However the consumer experience, frequent fluctuations in prices of vegetables in short runs. Because of this nature, vegetable production and its market system have been criticized over time. Since cultivation of vegetables involves intensive labor work, it provides more and regular employment opportunities in rural areas of the country and then it’s important to encourage the chance of creating more employment through farming.

The present study was conducted to identify the Socio-economic factors affecting the vegetable production in Balangoda D/S and to identify how input output markets and resource availability affect the same. The data were collected via questionnaires and face to face interviews through stratified random sampling. Sample only contains vegetable farmers among all wet land and dry land farmers

According to the data collected through Agrarian service centers, the cultivation extent and simultaneously the production volume of vegetable production of vegetable crops fluctuates rapidly due to an array of reasons. The study revealed that the subsidies provided by the government do not have a significant effect on the vegetable production which reflects the poor conditions of the policies related to subsidies. The farmers in the sample have to be encouraged to acquire financial assistance services; therefore more farmers will have enough capital to invest in vegetable farming operations.

So to promote the vegetable production more further in Balangoda D/S divisions the agrarian service centers and relevant institutes can insist on facilitating. The reasons for farmers to engage in vegetable cultivation operations and the degree of significance from each selected factor are discussed through the paper.

The study found that the engagement of middleman/intermediaries, gaining of satisfying profits and the age of the farmer are significantly associated with the extent of vegetable farming operations. The findings of the study lead to important recommendations where in the future, the effects from barriers to vegetable production can be minimized through their identification and contribute significantly to the national vegetable production.

ANTIOXIDANT AND AMYLASE INHIBITORY ACTIVITY OF MEDICINAL PLANTS IN SRI LANKA

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Recently, the interest in medicinal plant usage for treating several disease conditions has increased due to exerted beneficial properties such as antioxidant, anticancer, hypoglycaemic and hypolipidaemic activities. The present study was designed to assess the *in vitro* antioxidant and amylase inhibitory activity of Belimal (*Aegle marmelos*), Iramusu (*Hamidesmus indicus*), Ranawara (*Cassia auriculata*), Walkottamalli (*Scoparia dulcis*), Nelli (*Phyllanthus emblica*), Rasakinda (*Tinospora cordifolia*), Polpala (*Aerva lanata*), Babila (*Sida rhombifolia*), Beligeta (*Aegle marmelos*) and Venivel (*Coscinium fenestratum*), which are extensively used in the *Ayurvedic* medicine. Water extracts were evaluated for the antioxidant and amylase inhibitory activities. The antioxidant activity of the extracts was evaluated using DPPH (2,2-diphenyl-1-picryl-hydrazyl), ABTS (2,2'azinobis(3-ethylbenzothiozoline-6-sulfonic acid) diammonium salt) and the ferrous reducing antioxidant power (FRAP) assays. The amylase inhibitory activity of the extracts was tested using the starch- iodine and the glucose oxidase methods. The Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were also determined. The TPC and TFC of the extracts varied from 5.22±0.08 - 295.94±3.65 mg gallic acid equivalents (GAE)/g dry weight and 0.97±0.002 -115.01±1.69 mg catechin equivalent (CE)/g dry weight respectively. The DPPH and ABTS radical scavenging activities were higher for the *Nelli* extract while the least activity was observed in the *Venivel* extract. The FRAP activity of the extracts well proved with the DPPH and ABTS radical scavenging activities, where the *Nelli* extract exhibited the highest FRAP activity while the *Polpala* extract showed the least activity. The amylase inhibitory activity of the extracts in the starch-iodine and glucose oxidase method ranged from 3.69±0.26 - 152.09±3.93 mg/ml and 0.41±0.05 - 216.07±5.22 mg/ml, respectively. In both the assays the *Nelli* extract showed the highest inhibition while the least activity was observed in the *Rasakinda* extract. A positive, significant linear relationship between antioxidant and amylase inhibitory activity and the TPC and TFC content showed that phenolic compounds and flavonoids were the major compounds responsible for the exerted beneficial effects of the tested medicinal plants.

**INSTANT FOOD CONSUMPTION PATTERN AMONG
UNDERGRADUATES OF SABARAGAMUWA UNIVERSITY OF
SRI LANKA AND WAYAMBA UNIVERSITY OF SRI LANKA**

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Instant food can be defined as dried foods that reconstitute rapidly when water is added. Some needs to be heated before they are consumed. Some do not need any modification. University students are adopted to consume high amounts of instant food due to many factors. Subsequently students are also affected by illnesses like gastritis and are susceptible to many other diseases. These poor health and bad food habits are prominent mostly in residential universities. The main focus of this research was to find out the most popular instant foods, and to identify the consumption pattern of instant foods and demographic factors that affect purchasing of instant foods. The sample consisted of 149 university students from Sabaragamuwa University of Sri Lanka and Wayamba University of Sri Lanka. Descriptive analysis and non-parametric analysis (chi square) were performed to analyze the data. Rank based quotient (RBQ) was used to analyze the ranked data.

Out of the sample majority were female students (66%). The 61% of students were from semi-urban areas while 14% were from urban areas. Out of the total sample, 95% of students consumed instant foods. Most popular instant foods products were instant noodles, cereal mixture, cornflakes and instant soup. About 54.9% of students consumed instant food as an extra meal only and 31.7% consumed as both extra and main meal. There was a relationship between gender and instant food consumption. Factors such as easy to prepare, lack of availability of main meal, family influence and unsatisfactory foods in the cafeteria were associated with most of the socio demographic variables. The main variables which showed association were gender, residence and faculty of study. Three choices cards were presented to every student who only consumed instant food products. Students opted (66%) for choice B consisting of high price, local product, and high nutritional value. About 95.1% of students agreed that instant foods adversely affect human health. Findings posit the reason for students to go for instant foods. If it is possible to deal with these reasons properly, consumption of instant foods could be reduced at university level.

A COMPARISON OF PHYSICOCHEMICAL PROPERTIES OF BUTTER MADE FROM MILK DERIVED FROM THAMANKADUWA WHITE VS. FRIESIAN BREEDS IN SRI LANKA

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Milk fat is probably the most complex of all edible fats. More than 400 different fatty acids have been detected in milk lipids so far. Butter is one of the most popular and highly priced dairy products. However, butter is considered as one of the high risk factors causing coronary heart disease. Most prominent candidates for genes that might have an effect on milk fatty acid composition are the genes which directly involved in the synthesis of milk fat i.e., the *SCD1* gene and the *acyl coA: diacylglycerol acyltransferase1 (DGAT1)* gene. Milk fatty acid unsaturation indices have a substantial genetic component. Due to these reasons, it can be suspected that the butter which is entirely a fatty food item (80% milk fat) of animal origin may express different quality characteristics specially in their nutritional and textural attributes (i.e., fatty acid composition, cold spreadability, softness/hardness) according to the breed from which the milk is derived. However, under current context evidences on such researches are lacking. Therefore, the aim of the present study was to determine the possible breed effect on variation in butter quality characteristics especially in terms of textural and microstructural attributes.

Thamankaduwa white breed and Friesian breed in Sri Lanka were selected and a total of 33 L of milk (n=3) and 51 L of milk (n=3) was collected from the two breeds, respectively. Randomly collected bulk feed samples (n=5) of the two breeds were analyzed for feed fat percentage. All the milk samples were processed separately into salted sweet cream butter having 1% (w/w) of salt. Microstructures were observed using inverted and phase contrast microscopes. Sensory analysis was performed mainly focusing texture and cold spreadability (at 5°C) of butter using three untrained panels (n=40). Hardness of butter was analyzed using a texture analyzer. Proximate compositions were analyzed and the yield efficiency data, i.e., cream yield, butter yield and churning efficiency, were calculated. Objective data were statistically analyzed using completely randomized design with Analysis of Covariance (ANOCOVA) and the sensory data were analyzed using Friedman non-parametric test.

Major findings suggest that there was a difference in terms of overall texture, cold spreadability and hardness of butter samples ($p < 0.05$). The butter made from Thamankaduwa White breed was more softer and had higher cold spreadability than that of Friesian breed while preference on overall texture of the Thamankaduwa White breed butter was lower than that of the Friesian breed ($p < 0.05$). The microstructural studies confirmed that there were no prominent differences between microstructure of butter samples. Since the milk samples were standardized prior to butter production, there were no prominent differences between proximate compositions of butter samples. The efficiency of production of butter from raw milk was higher in Thamankaduwa breed ($p < 0.05$).

Therefore, the major findings uphold the conclusion that there is a significant difference especially in terms of textural attributes of butters which are produced from two different breeds. Also milk from Thamankaduwa white breed is better than that of Friesian breed in terms of butter making process.

SENSITIVITY ANALYSIS OF THE MAXIMUM TEMPERATURE IN THE SEED PASTE BEING EXPRESSED IN A SCREW EXPELLER

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Screw expeller can be effectively used for the expression of cold-pressed oil (at temperatures not exceeding 50 °C) which is known to have significant health benefits. However, viscous heat produced by the shearing action prevailing in a moving seed paste may result in increased seed paste temperature during oil expression which has direct impact upon the oil quality. The objective of this study was to use a mathematical model to estimate the maximum temperature experienced by the seed paste expressed in a screw expeller. This study specifically focuses on the determination of the parameters (among density (ρ), thermal conductivity (k), viscosity (μ) and natural heat transfer coefficient (h)) that are most influential on the maximum temperature of oil expressed. This was achieved by solving the mathematical model of the seed paste through a screw expeller using COMSOL Multiphysics® Modelling Software (will be referred to as COMSOL henceforth) complemented by Taguchi orthogonal array design. This combination was a novel approach. The response variable was taken as the maximum temperature (T_{\max}) experienced by the seed paste expressed. For the modeling, seed paste was unwrapped neglecting curvature effects of the screw expeller. Mass, momentum and energy transport equations were incorporated in the model by ignoring inertial effects. In the simulation literature, there were two common boundary conditions used as equivalent. One considers stationary barrel in relation to rotating screw root and flights. The other considers rotating barrel in relation to stationary screw root and flights. For the two sets of boundary conditions used, COMSOL simulation results varied significantly. Even though the two sets of boundary conditions considered were treated as equivalent in the sense of relative velocity in many cases, it was not the case for the system studied here. Thus, the study was confined to the true boundary conditions, which were stationary barrel and rotating screw root and flights. Secondly, dimensionless flow rates for varying dimensionless pressure gradients were estimated using COMSOL for the experimental values available in research literature, and close agreement was found between the two. Sensitivity analysis was carried out in the temperature range of 35 to 75°C, which was similar to the operating temperature range of the screw expeller that is expected to be used in the future. In the chosen temperature range, ρ , k , μ and h of the sesame seed paste (oil + cake) varied in the ranges of 1172 to 1156 kg/m³, 0.198 to 0.207 W/m K, 2.12 to 0.80 Pa s, and 4.67 to 7.14 W/m² K, respectively. The COMSOL results obtained for a Taguchi design showed that T_{\max} was sensitive to μ and h , and could be described by $T_{\max} = 64.09\mu - 5.29\mu h + 26.71$. As per the model, cross effect between μ and h had considerable influence on T_{\max} . By a combination of COMSOL simulations and Taguchi orthogonal array design of experiments, it has been shown that the maximum temperature of the seed paste being expressed is sensitive to μ of the paste and h of the air surrounding the screw expeller. Accurate determination of the values of μ and h are therefore imperative to aid comparison between the temperature profiles obtained in an experiment with that of the simulated model.

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INFLUENCE OF PACKAGING ATTRIBUTES ON CONSUMER'S PURCHASING DECISION OF PASTEURIZED MILK

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The role of packaging has changed due to increasing self-service and changing consumers' lifestyle in the competitive business environment. Markets for food products including pasteurized milk are very competitive. Many well equipped competitors are available in the market and they are ready to fight in all areas of their marketing strategy. Packaging attributes are one of the most important factors affecting the consumer's purchase decision. Package also becomes an ultimate selling proposition stimulating impulsive buying behavior, increasing market share and reducing promotional costs. Packaging is the final point of communication between a brand and consumer in the retail environment. For this reason, the packaging is one of the most important points of interaction between the brand and consumer. Objective of this study was to find out the influence of packaging attributes on buying decision in Dompe division. Pre-tested interviewer administrated questionnaires were used to collect data. Total of 120 respondents were selected based on the simple random sampling method. Data collected included demographic factors (gender, age, education level, occupation, income) and packaging attributes (packaging color, packaging material, packaging shape, innovation in packaging, printed information, brand name). Quantitative data were analyzed using descriptive analysis, chi-square test and correlation analysis techniques. Microsoft Excel and SPSS 16.0 software packages were used for the analysis. Among all other demographic factors, income level and age were positively correlated with the purchasing decision of pasteurized milk. Brand name, packaging material, quality of packaging material and innovation of packaging were the most important packaging attributes that affected the buying decision of pasteurized milk in Dompe division.

BIOACTIVE AND NUTRITIONAL PROPERTIES OF AERIAL PARTS OF *TRICHOSANTHES CUCUMERINA* LINN

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Snake gourd (*Trichosanthes cucumerina* Linn.) is commonly used as food as well as in the traditional systems of medicine for the preparation of formulations to treat a variety of disease conditions. The plant is rich in phytochemicals, dietary fiber and essential mineral elements, which make the plant pharmacologically and therapeutically active. Hence, the present investigation was conducted to determine the nutritional and functional properties of *T. cucumerina*.

Water extracts of the freeze dried flowers, fruits harvested in two weeks after fruit set and tender leaves of *T. cucumerina* (TA-2 variety) were used for the study. Each sample from each plant part was evaluated in triplicates for its total phenolic content (TPC), total flavonoid content (TFC) and the antioxidant capacity using 2,2-diphenyl-1-picrylhydrazyl (DPPH), 3-ethylbenzothiazoline-6-sulfonic acid (ABTS) and ferric ion reducing antioxidant power (FRAP) assays. α -Amylase inhibitory activity was analyzed using 3,5-dinitrosalicylic acid (DNSA), starch-iodine, glucose oxidase and starch hydrolase methods. Mineral elements, both soluble and insoluble dietary fiber contents were also analyzed.

Antioxidant activity, TPC and TFC were significantly ($P < 0.05$) higher in leaf samples than flowers and fruits. A significant linear correlation was observed between the TPC, TFC and antioxidant activities of plant extracts. In the DNSA, starch-iodine and starch hydrolase methods, the leaves and flower samples showed significantly ($P < 0.05$) higher inhibition than the fruit. Soluble and insoluble dietary fiber contents were significantly ($P < 0.05$) higher in fruit than in flower and leaf. Ca and K contents were significantly ($P < 0.05$) high in leaf followed by fruit and flower in fresh weight basis (FWB) and Mg, Fe and Zn contents were significantly ($P < 0.05$) high in leaf followed by flower and fruit in FWB. In conclusion, *T. cucumerina* can be considered as a promising candidate, which possesses high nutritional and functional benefits in advancing human health.

A STUDY ON THE DEVELOPMENT AND QUALITY ASSESSMENT OF PINEAPPLE POWDER AS A VALUE ADDED INGREDIENT FOR FOOD PRODUCTS

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Pineapple is a major fruit crop that has achieved tremendous popularity over the last few decades. It is an important fruit, which is rich in vitamins, minerals and fibre. Pineapples are not properly utilized especially during the peak production season due to lack of knowledge in using appropriate technologies. Dehydration of pineapple into powdered particles is an effective method of prolonging the shelf life of the fruits. There is a potential to use the pineapple powder in drinks, confectionaries, baby foods and bakery products. Therefore, a research was conducted to develop the pineapple powder and to assess the quality attributes during storage. Fully ripen pineapples were washed and peeled, and thorny eyes were removed. Fruits were cut into 2 cm cubes and the cubes were dipped in 5% citric acid solution for 20 minutes to prevent the brown discolouration. These cubes were placed in a solar drier and dried at 60 °C for 16-18 hours until the cubes become leathery and non-sticky. After drying, they were cooled and ground into powder. This pineapple powder was stored in airtight bottles at ambient conditions of 30 °C and 70–75% RH for 8 weeks.

The pineapple powder was subjected to nutritional, sensory and microbial assessment after the development and during storage. Nutritional parameters of moisture, titratable acidity, ascorbic acid, total sugar, total soluble solids and fibre were analysed for the pineapple powder. Sensory attributes of colour, texture, flavour, absence of browning and overall acceptability were evaluated by 30 consumer panellists. The nutritional analysis of the fresh pineapple powder contained 6% moisture, 0.64% titratable acidity (as citric acid), 57.2 mg/100g ascorbic acid, 12.8% total sugar, 13.2 total soluble solids (°Brix) and 0.47% fibre. Nutritional analysis of stored powder showed a decreasing trend in ascorbic acid, total sugar, total soluble solids and crude fiber and an increasing trend for moisture and titratable acidity. After 8 weeks in storage, the pineapple powder contained 6.96% moisture, 0.86% titratable acidity (as citric acid), 55.5 mg/100g ascorbic acid, 11.3% total sugar, 12.3 total soluble solids (°Brix) and 0.38% fibre. The sensory assessment of stored powder revealed that there were no significant differences among the sensory attributes after storage. The microbiological assessment, in terms of total plate count revealed that microbes were absent during development and after storage. Based on the quality assessment, pineapple powder could be stored for 8 weeks without any significant changes in the quality attributes and used for the production of pineapple based value added food products.

A STUDY ON FATTY ACID COMPOSITION OF OIL EXTRACTED FROM CRAB (*PORTUNUS PELAGICUS*) MEAT AND FISH OIL

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Seafood lipids are rich in polyunsaturated fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Analysis of fatty acids has become increasingly important in human nutrition. In this study, meat of male crab was analyzed for fatty acid composition. Extracted oil from crab meat (n=3) and fish oil samples (n=3) were also analyzed for fatty acid composition by gas-liquid chromatography. High amount of polyunsaturated fatty acids was founded in crab oil accounting for 40.68% of the total fatty acid content. The predominant saturated fatty acid was palmitic acid (20.18%). Oleic acid (28.03%) was the major monounsaturated fatty acids in crab meat followed by EPA (12.12%) and DHA (17.17%). Oil extracted from crab meat contained high amounts of oleic acid (28.03%) and eicosapentaenoic acid (12.12%) compared to commercial fish oil samples tested. Total saturated fatty acids was highest in fish oil (42.48%) and lowest (27.41%) in crab meat. Fish oil contained 17.97% palmitic acid, 18.45% oleic acid, 3.87% EPA and 25.17% DHA. In conclusion, this study revealed that EPA and oleic acid contents were higher in of *P. pelagicus* than in fish oil. Omega 3 fatty acid content was higher in crab meat than in fish oil. Therefore, crab meat (*P. pelagicus*) is more suitable as a supplement of omega 3-fatty acid than fish oil.

DEVELOPMENT OF CEREAL AND PULSE BASED YOGHURT FOR TODDLERS

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Toddlers are the small children who are in the age of 12 - 24 months, who need high amount of nutrition since their growth and development is high during this period. Incorporating cereal, pulses and fruits with probiotics into a yoghurt could provide almost all the nutrient requirements for toddlers. Therefore, this study focused on developing a modified yoghurt formula containing cereals and pulses for toddlers. Ranking test for four different ratios of rice, corn, mung bean and soya bean was conducted using 5 trained panellists for the flavour and texture of yoghurt by incorporating 3% of the flour mixture. The selected flour mixtures were incorporated in percentages of 5%, 7.5% and 10% to the yoghurt with 5% mixed berry fruit puree. Hedonic tests for colour, fruity flavour, overall taste, texture and overall acceptability were conducted using 30 consumer panellists having 1-3 year old children to select the best percentage. The probiotic culture was added as specified. The proximate composition of the yoghurt was determined. A storage study at 4 °C was conducted using two types of preservatives; potassium sorbate and preservative culture (*Lactobacillus rhamnosus* and *Propionibacterium freudenreichii* subsp. *Shermanii*) where growth of yeast and mould, coliform and syneresis were evaluated in each 4 days interval. After 21 days, a hedonic test was conducted to study the acceptance of yoghurt samples based on flavour, colour and texture using 5 trained panellists. Rice: corn: soya: mung bean mixture at percentage of 50%, 25%, 10%, 15% was significantly ($p < 0.05$) preferred. All the treatments were significantly different ($p < 0.05$) for tested attributes except for texture whereas yoghurt containing 5% flour mixture was the most acceptable. The contents of total soluble solid, crude protein, fat, fibre, ash and vitamin C were 26.04±0.01%, 5.98±0.13%, 3.17±0.02%, 0.92±0.09%, 0.69±0.5 %, 0.62±0.29% respectively. Yeast and mould and coliform were absent in any of the tested time intervals and syneresis was not observed. There was no significant difference ($p < 0.05$) in the acceptance for both yoghurt samples compared to the freshly prepared yoghurt in all the tested attributes.

EFFECT OF EXTRACTION TEMPERATURE UPON THE QUALITY OF SESAME OIL, AND INVESTIGATION OF FACTORS AFFECTING ITS MARKETABILITY IN SRI LANKA

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Sesame (*Sesamum indicum* L.) oil is an underutilized oil with a high potential to compete with other vegetable oils. This study addresses two issues; impact of extraction temperature upon the quality of sesame oil; the factors affecting its marketability.

Sesame seeds (MI-2), dried at 60°C (cross-flow air drier; 3.76±0.15% moisture content), were expelled in a screw-type expeller (DL-ZY-J02) operated at 38.98±0.47°C (SO40) and 60.66±3.21°C (SO60) as treatments in triplicate, and the two oil samples were subjected to physicochemical analyses. Refractive index (40°C), moisture content (%wb), water activity (24.94±0.12°C), saponification, and iodine values, unsaponifiable matter (%) and free fatty acid (oleic acid %) of SO60 samples were 1.47, 0.21±0.07, 0.86±0.01, 191.68±4.26, 104.56±0.51, 1.75±0.09, and 0.15±0.02 respectively, and the peroxide value was not detectable. SO40 samples were not significantly different ($P>0.05$) from SO60 samples in physicochemical properties, which are within the specifications of SL and Codex standards. Extraction at 60.66±3.21°C resulted in a significantly higher ($P<0.05$) oil yield (38.44±2.05%) than at 38.98±0.47°C (30.08±1.49%). Impact of extraction temperatures upon the sensory attributes of the oil tested by evaluating the overall acceptability (paired-preference test; 30 consumer panelists; boiled potato as the carrier) revealed that SO60 was significantly better ($P<0.05$) than SO40 showing 73.3 and 26.7% preferences respectively.

A consumer survey conducted revealed that 86% out of 50 users of sesame oil buy the local products and 66% them was not satisfied with the quality. Informal interviews conducted with non-users revealed high price, inaccessibility and displeasing odour as major constraints of sesame oil use. Market situation of edible oils analyzed by observing 12 randomly selected supermarkets (Kandy, Colombo and Kegalle districts) revealed that sesame oil was comparatively less popular than other oils. Extraction of sesame oil at 60°C can be recommended, even though 50°C is considered the maximum extraction temperature for cold pressed oil.

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COMPARISON OF THE QUALITY OF COMMERCIALY AVAILABLE SESAME OIL PRODUCED BY *SEKKU* AND BY SCREW EXPELLER

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Despite the history, traditional medicinal usages, indigenous character and availability of sesame and sesame oil in Sri Lanka, none of the Sri Lankan sesame oil producer so far has got the Sri Lanka Standards (SLS) certification for their oils due to noncompliance with the quality parameters set by SLS Institute; most importantly, free fatty acid (FFA) content and saponification value (SV). FFAs are created when the fatty acids are separated from the fat molecule, which is caused by enzymes, light, water and/or heat. Lower values of FFA signify better storage and shelf life of the oil concerned. SV measures the average molecular weight of all the fatty acids present in oil, and hence helps to identify adulteration of oil. Low values of SV signify long chain fatty acids having less number of carboxylic functional groups per unit mass of oil. In this study, we tested sesame oil samples produced in Sri Lanka using two distinctly different technologies for FFA and SV, along with refractive index (RI). This study was carried out to assess the research effort required to enhance the quality of sesame oil produced in Sri Lanka.

We procured 24 commercially available sesame oil samples from Sri Lankan oil producers themselves; 12 samples produced using *sekku* and 12 produced using screw expeller. *Sekku* refers to the traditional sesame oil production technology. In a *sekku*, scooped circular pit in the central fixed wooden chamber acts as a mortar and holds sesame seeds. A stout wooden pestle was used to crush the seeds and then to squeeze out the oil from the seeds. Sample preparation for RI, FFA and SV tests and the tests themselves were carried out according to SLS. Samples were randomized before testing to reduce possible bias. If the quality of a certain product available in the market is to be considered reliable, it should be normally distributed with a small value for standard deviation. It is therefore, we tested the ability of the measured values of FFA and SV of the oil samples to describe normal distributions. Anderson-Darling test was used to test if the sample considered came from a population with a normal distribution.

Test results testified that all samples complied well with the SLS specified RI range and the SLS specified maximum allowable FFA content. In case of FFA content, Anderson-Darling test statistics did not reject the null hypothesis that FFAs of the populations considered were normally distributed for both technologies studied. It is therefore, sesame oils produced by the chosen two technologies can be considered as of reliable quality with respect to FFA content. Anderson-Darling test statistic did not reject normal distribution of SVs for *sekku* produced oil samples. It rejected normal distribution of the SVs for screw expeller produced oil samples. In both cases, however, the mean values of the SVs did not fall within the SLS specified range. It is therefore, the quality of sesame oils produced by the chosen two technologies can be considered as unreliable with respect to SV. Further research is required to identify the cause for non-compliance of Sri Lankan produced sesame oil with the SLS specified range of saponification values, considering the fact that the commercially available Sri Lankan sesame oils produced using the said technologies are crude in the sense that they are not only unrefined but also unfiltered.

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EFFECT OF PHYSICALLY STRUCTURED WATER PRODUCED BY NANO-TOURMALINE IMPREGNATED CERAMIC BEADS ON IMPROVING EXTRACTABILITY OF CAFFEINE, CURCUMIN AND OIL EMULSIFICATION

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Physically structured water (PSW) possesses reduced molecular cluster structure. The study researched into identifying the effect of PSW on caffeine and curcumin extractability and oil emulsification. PSW obtained using a column of nano-tourmaline impregnated ceramic balls was compared with non-structured water (NSW) based on physical properties. ORP, pH and NMR frequency of PSW and NSW were different ($P > 0.05$), and were -113 & +97 mV, 8.64±0.08 & 6.83±0.06 and 55 & 120-Hz respectively. Caffeine was extracted from black tea, green tea, coffee and instant coffee at 24.5±0.2 and 95±2°C for 30 min in triplicate using PSW and NSW (2x2 factorial, CRD) and quantified by spectrophotometry (273 nm). PSW increased ($P < 0.05$) the extractability of caffeine at 95°C by 83.6% (black tea), 79.7% (coffee), 56.6% (green tea) and 3.6% (instant coffee). Caffeine contents from black tea (63.2 mg l⁻¹), coffee (60.2 mg l⁻¹) and instant coffee (135.0 mg l⁻¹) with PSW at 24.5±0.2°C were not different ($P > 0.05$) from the contents extracted at 95±2°C with NSW. Curcumin was extracted from turmeric powder (sieve size, 300 μ) at 24.5±0.2 and 95±2°C for 20 min in triplicate using PSW and NSW (2x2 factorial, CRD), and the absorbencies (420nm) of the extracts were compared. PSW increased ($P < 0.05$) the extractability of curcumin at 95±2°C by 430% and at 24.5±0.2°C by 282%. Virgin coconut (VCO), sunflower and olive oils were sonicated (50-Hz, 5min) in triplicate with PSW and NSW in a CRD, and the turbidity at 500nm were measured daily for 6 days. Turbidity of VCO was significantly higher ($P < 0.05$) by 1.1-, 1.2-, 1.2-, 1.2-, 1.2- and 1.5-fold on day 1, 2, 3, 4, 5 and 6 respectively when treated with PSW than with NSW. Similar pattern of turbidity was evident in other oils. PSW is more effective than NSW in extracting caffeine and curcumin and emulsifying oil.

MORPHOLOGICAL AND PRODUCTION SYSTEM CHARACTERISTICS OF INDIGENOUS WHITE CATTLE IN SRI LANKA

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Sri Lankan indigenous cattle population remains as a nondescript type of animal except for few breeds. Thamankaduwa cattle or white cattle, which confined to an isolated breeding track in eastern region of Sri Lanka is one of the local breeds identified but not properly described. Hence, a study was conducted to evaluate the breed status and its current farming system of White cattle in the Trincomalee district.

Breed characteristics were assessed based on criteria specified by the Food and Agriculture Organization using 100 mature cattle in 11 veterinary surgeon ranges and the management aspects and socio economic status were collected using a pre-tested structured questionnaire. Data were analyzed using SPSS (Version 16). White cattle could be described as a cattle with white coat color, short and glossy mostly curly hair type, long and narrow head with flat forehead and angular body shape with small hump. Females have poorly developed udders and smaller hump. In general, both male and female have horns with different orientations. Body length, height at withers, heart girth, head length, head width, ear length, height at rump, rump width and rump length at female adult White cattle were (cm) 107.35 ± 9.29 , 107.25 ± 8.17 , 140.63 ± 10.60 , 40.42 ± 4.02 , 17.31 ± 1.66 , 20.96 ± 1.81 , 114.68 ± 7.52 , 35.06 ± 3.28 and 31.58 ± 3.27 , respectively, where, those in male cattle were (cm) 116.31 ± 9.28 , 114.75 ± 11.96 , 148.25 ± 7.33 , 42.0 ± 2.78 , 17.50 ± 1.37 , 22.50 ± 1.15 , 122.44 ± 9.06 , 36.50 ± 3.31 and 32.69 ± 2.15 , respectively. However, no difference ($P > 0.05$) was observed between the morphometric measurements of males and females probably owing to few males found in the study. Farming system analysis depicted that indigenous white cattle are reared under traditional livestock systems and operated under limited input basis as small scale farming (70.2%) with less than 20 heads in a herd. Free grazing and tethered feeding are the two predominant practices in dry (78.9%) and wet (49.1%) seasons, respectively. In general, cattle are confined to paddocks during night while some farmers (19.3%) provide permanent sheds. Only few farmers (12.3%) practice semi-intensive system where cattle are provided with supplementary feed comprise of rice bran and crop residue. Hence, milk production is low as 1.6 L on average. Majority of farms (82.5%) did not use treatments against commonly occurring health problems. There is a strong relationship between cattle farming and socio-cultural condition in the area where majority of cattle farmers are male (90%), middle aged (31 to 40 years) Hindus (72%) educated only up to primary level. The main occupation of majority of farmers (53%) was livestock and considerable number of farmers (30%) had their sole income generated by cattle farming. Experience in cattle farming is the common knowledge base for most of the farmers (57.9%) where majority (56%) had more than 10 years of experience. Indigenous white cattle are a unique genetic resource well adapted to the prevailing farming system in the area. They play multiple roles in the local social, economic and cultural structure of the region, and need a proper attention in both herd improvement and conservation programs.

EFFECT OF ECOTYPES AND FEEDING SYSTEMS ON THE QUALITY AND FUNCTIONAL PROPERTIES OF BACKYARD CHICKEN EGGS

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Egg is considered as a nutritious food source and multipurpose ingredient in different food preparations. Qualities and functional properties of eggs are the most important aspects to be considered in commercial chicken rearing. Though attention has been paid to commercial chicken on this aspect, village chicken egg has not been evaluated adequately for its quality attributes. The present study was under taken therefore to evaluate the quality and functional properties of eggs from different village chicken ecotypes, and also those raised under different feeding systems.

Eggs from three village chicken ecotypes, Normal Village Chicken (NVC), Naked Neck (NN) and Long Leg (LL), were used to evaluate internal & external qualities and functional properties. Also a total of 81 eggs from normal village chicken reared under three feeding systems, green materials and scavenged feed (GMS), scavenged feed only (S) and commercial feed and scavenged feed (CS) were tested for the same set of properties. Further, ultra-structural analysis of egg shells of three ecotypes were compared with that of commercial chicken (Shaver brown)

The results revealed that egg weight, egg length, egg width, albumin height, yolk height, yolk diameter, Haugh unit, yolk index, shell thickness, foaming stability and gelling strength were not significantly ($P>0.05$) different among three ecotypes. Shape indices and air cell depth were significantly ($P<0.05$) differed between NN and LL chicken eggs while Long Leg having the highest values of shape index (76.64) and air cell depth (5.69 mm). Yolk color was significantly ($P<0.05$) low in NN eggs. Feeding system has significantly ($P<0.05$) influenced the egg weight where scavenging feeding showed low egg weight but high shape index (in GMS). Despite that ecotype and feeding system had no influence on the functional properties of eggs, comparison of NVC with commercial chicken eggs showed that Haugh unit, gel strength, foaming stability and yolk colour values of NVC eggs were significantly high ($P<0.05$). Eggshell structure was similar in all ecotypes. However, eggshell thickness of commercial chicken was significantly ($P<0.05$) higher than that of village chicken. Although palisade% was not showing any significant ($P>0.05$) difference among three feeding systems, palisade% of commercial chicken was significantly ($P<0.05$) high revealing that commercial chicken egg shell strength is high. Palisade layer provides the stiffness characteristics of the shell and thereby shell strength.

The influence of Village chicken ecotype and feeding system on certain egg quality characteristics and functional properties observed in the preset study could provide useful directives in selection and breeding programs for improvement and conservation of indigenous chicken genetic resources of the country.

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EVALUATION OF METHODS IN DETERMINATION OF SUGAR CONTENT OF BLACK TEA TO DETECT ADULTERATIONS

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Tea (*Camellia sinensis* (L.) O. kuntze) is one of the major foreign exchange earning crops in Sri Lanka. Sugar adulteration in black tea has become a significant problem in tea industry, which adversely affects the reputation of “Ceylon black tea”. During the process, some of the manufacturers add sugar to withered tea leaves to improve the blackness and organoleptic properties of made tea.

However, standard procedure to detect sugar adulteration in black tea has yet to be established. Thus the present study was conducted to find the applicability of the existing test methods in determination of sugars in black tea and to develop a convenient method to quantify the same. Polyphenols are the major group of compounds, which interfere in detection of sugars in black tea.

More than 99 % of polyphenolic compounds present in the initial hot water extract of black tea was able to be removed by treating the tea extract with (50 % w/v) neutral lead acetate followed by 9 % (v/v) sulfuric acid. Black tea samples were prepared from five different tea cultivars (TRI 777, TRI 2025, TRI 3015, TRI 4052 and TRI 5000) with different levels of sugar (0 g, 2.5 g, 5 g, 7.5 g, 10 g) per 1kg of withered tea leaves. Internal calibration graphs for ungraded black tea were constructed using the prepared black tea samples for Anthrone, Phenol Sulfuric, Modified Lane and Eynone methods.

All methods showed linear relationship with sugar levels. Sugar levels of unadulterated black tea samples were not consistent due to the difference in extraction along with the particle sizes of the black tea. Results revealed that Anthrone, Phenol Sulfuric, Modified Lane and Eynone methods can be successfully use in determination of sugar adulteration in black tea, however, base lines has to be established for different tea grades, seasons and regions.

A CASE STUDY ON INFECTIOUS BURSAL DISEASE AND NEW CASTLE DISEASE IN RELATION TO CLIMATIC PATTERN IN POULTRY IN NORTH CENTRAL PROVINCE OF SRI LANKA

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Infectious Bursal Disease (IBD) and New Castle Disease (NCD) are viral diseases which cause huge economic losses in poultry industry of Sri Lanka. A retrospective study was conducted to analyze the pattern of occurrence of IBD and NCD in relation to the climatic pattern within a year during the period from 2009 to 2013, in the North Central Province, Sri Lanka.

Monthly records of IBD and NCD clinical cases were collected from Department of Animal Production and Health (DAPH), Sri Lanka. The daily temperature and daily rainfall data of the study area were obtained from the Natural Resources Management Center (NRMC), Department of Agriculture, Sri Lanka. The monthly average of maximum temperature was ranked into six categories; <29 °C, 29–30 °C, 30-31 °C, 31-32 °C, 32-33 °C and >33 °C. The monthly cumulative rainfall was grouped into two categories; < 200 mm and > 200 mm. Disease counts were taken as lag 0, lag 1 and lag 2, where lag 0 was analysis of the relationship between IBD and NCD clinical data with the same month's climatic data lag 1 was the analysis of IBD and NCD clinical data with previous month's climatic data and lag 2 was analysis of IBD and NCD clinical data with previous two month's climatic data. The yearly patterns of the occurrence of IBD and NCD were analyzed from the year 2009 to 2013. The maximum monthly average temperature and monthly cumulative rainfall were individually tested for both IBD and NCD counts (lag 0, lag 1 and lag 2) using Spearman's rank correlation coefficient (SRCC) (MINITAB 17 software). The cumulative effects of monthly average maximum temperature and monthly rainfall for disease counts of both diseases (lag 0, lag 1 and lag 2) were tested with Chi-Square test and Pearson Contingency Coefficient (PCC) test.

High number of IBD cases could be expected during the months of February, September and October and high number of NCD cases could be expected during the months of April and October in the study area. Only monthly cumulative rain fall and lag 1 NCD occurrences had a significant SRCC of 0.263 (P<0.05). However, when both factors are considered together, all lags of IBD showed significant associations with both temperature and rainfall (P<0.05) and PCC were 0.36, 0.44 and 0.61 for lag 0, lag 1 and lag 2, respectively. Further, NCD also showed significant associations with temperature and rainfall for all lag NCD counts (P<0.05) and PCC were 0.55, 0.66 and 0.64 for lag 0, lag 1 and lag 2, respectively. Lag 2 IBD disease count and Lag 1 NCD disease count had the strongest relationship with climatic pattern. Therefore, IBD occurrence depends on the climate prevailed in two months before while NCD occurrence depends on the climate of the previous month. However, other than climate, age of birds, vaccinations procedures, type of vaccine, vaccination schedule, occurrence of other immunosuppressive diseases and nutrition of the birds etc also may have affected the occurrence of IBD and NCD.

This study results emphasizes the importance of studying the association of disease occurrence with climatic pattern in order to carry out a disease prevention program effectively.

COMPARISON OF TABLE CHICKEN EGGS SOLD IN FOUR DISTRICTS IN SRI LANKA BASED ON QUALITY ATTRIBUTES

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Quality of eggs is one of major factors, which affect consumer acceptability. Therefore, egg quality plays an important role in marketability, which is economically important. The main purpose of this study was to assess the quality attributes of table chicken eggs sold in retailer markets located in the Kandy, Puttalam, Kurunegala and Gampaha districts.

Total of 125 eggs, purchased from retailer markets, were assessed based on the internal, external and functional qualities of eggs. The average egg weight, shell strength, shell thickness, air cell depth, yolk color (Roche color value), shape index, yolk index, Haugh Unit (HU), foaming stability and gel strength of the eggs were 57 ± 0.52 g, 33 ± 2.58 N, 0.15 ± 0.01 mm, 7 ± 0.18 mm, 5, $72\pm 0.01\%$, 0.32 ± 0.005 , 51 ± 1.69 , $79\pm 5.10\%$ and 10 ± 1.19 N, respectively. Fifty percent of the eggs had desirable shape index. Only 13% had desirable HU values according to Sri Lankan Standards (SLS) for chicken eggs. Moreover, based on egg weight grade classes (extra large, large, medium and small) specified in SLS, 54% of the eggs were large and, 28, 14 and 4% were extra-large, medium and small, respectively. The weight of eggs purchased from the Kurunegala district was significantly lower ($p<0.05$) than those from the Kandy, Puttalam, Gampaha districts. At least one of the quality characteristics of the eggs evaluated, except eggshell thickness, was significantly different.

Thirteen percent of the eggs available in retailer markets in the Kandy, Puttalam, Kurunegala and Gampaha districts was within the desirable range specified by SLS based on HU and 7% on air cell depth.

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BOVINE TUBERCULOSIS: A HISTOPATHOLOGICAL STUDY OF THE LUNG LESIONS

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Bovine tuberculosis caused by *Mycobacterium* species is a chronic and contagious disease that results in loss of production leading to high economic losses in cattle industry. Moreover, some of the cattle *Mycobacterium* species are reported to be responsible for causing the disease in humans. Although several methods including bacterial culture and molecular techniques are available, histopathology remains a relatively rapid and reliable method for diagnosis of the disease. This paper describes the histopathological changes in the lungs of cattle affected with tuberculosis.

Lung tissue with gross lesions suggestive of tuberculosis collected from 15 cattle formed the basis of this study. Tuberculosis caused by *Mycobacterium* spp. was later confirmed using microbiology in all the animals. All the lung samples were fixed in 10% neutral buffered formol saline immediately after the collection and subsequently subjected to standard histological processing. The paraffin embedded tissue sections were cut at 4 μ and stained with haematoxylin and eosin (H&E). Some selected tissue sections were subjected to acid fast staining using the techniques viz., Modified Ziehl- Neelson's, Gabbett's and Kinyoun's. All the stained micro-sections were studied under light microscope and the histopathological changes were recorded.

All the lung samples contained well demarcated, multifocal and coalescing granulomas of variable sizes with caseous necrotic centres in the parenchyma. Four (26.66%) of the samples showed calcification of the lesions while pulmonary oedema was seen in five (33.33%) of them. Multifocal parenchymal and interstitial fibrosis of varying degree was a prominent feature of all the lungs. Infiltration of mononuclear inflammatory cells, predominately lymphocytes and macrophages of varying number outside the granulomas was another common finding of the affected lungs. The granulomas were consisted of a caseous centre and concentric layers of macrophages with epithelioid and Langhan's giant cells, lymphocytes and fibrous tissue giving a classical picture. Fourteen out of the 15 (93.33%) lungs contained acid fast stained *Mycobacterium* bacilli as demonstrated by Kinyoun's technique. However, positive percentages of Modified Ziehl-Neelson's and Gabbett's techniques were 73.33 and 80 respectively.

The present findings indicate that histopathology can be used in diagnosis of pulmonary lesions of bovine tuberculosis. Moreover, Kinyoun's acid fast staining technique is the preferred method to demonstrate *Mycobacterium* bacilli histopathologically.

EFFECT OF LIPID PEROXIDATION ON PROTEIN QUALITY OF SNAKEHEAD FISH (*CHANNA STRIATA*) STORED AT -10°C FOR 28 DAYS

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The experiment was conducted to determine the progression of lipid peroxidation and the effects of it on protein quality of Snakehead fish (*Channa striata*) stored at -10 °C for 28 days. Fish were harvested from Victoria reservoir and transported to the laboratory under ice. After removal of skin, epaxial muscles were taken, wrapped in aluminum foil, sealed in polythene sacs, and stored at -10 °C until used. The samples were evaluated for Thiobarbituric Acid Reactive Substances (TBARS) using distillation method as peroxidative index while Salt Soluble Protein (SSP) content was determined as an index of protein quality deterioration on day 0, 7, 14, 21 and 28. The experiment was repeated six times each with three replicates and the data were expressed as mean ± SEM.

The day 0 value of TBARS in each experiment varied from 0.4236± 0.03875 mg/ kg to 1.2057 ±0.0915 mg/ kg. This difference might be due to individual variations of fat content in each fish. However, there was a significant ($P < 0.05$) increase of TBARS in each experiment during 28 day storage period from 0.5971±0.0413 to 1.751±0.119 mg/ kg.

On the other hand, SSP contents decreased gradually from day 0 (8.078 ± 0.503 mg/ g) to day 28 (2.19 ± 0.253 mg/ g) and found to be significant ($P < 0.05$). Further, there was a significant negative co-relation ($R^2 > 0.8$) between variation of TBARS and SSP contents.

Increment of TBARS contents indicates continuous peroxidation of lipids in Snakehead fish stored at -10 °C for 28 days. Reduction of SSP indicates gradual deterioration of muscle protein quality. The negative co-relation between two parameters demonstrated deleterious effect of peroxidation on protein quality. However, the TBAR content did not exceed the maximum permissible level (4.5 mg/ kg) even on day 28 at -10 °C indicating the safety of Snakehead fish consumption.

**BIOCHEMICAL CHANGES OF NILE TILAPIA
(*Oreochromis niloticus*) STORED IN -10°C**

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Nile tilapia being the most consumed fresh water food fish species in Sri Lanka, it is important to study the biochemical changes taking place during storage of the fish after slaughter. The changes occurring during the storage was assessed using three parameters; namely malondialdehyde (MDA), Salt Soluble Protein (SSP) and pH as indicators of lipid peroxidation, protein deterioration and microbial activity respectively. Tilapia were obtained from Wahalkada Reservoir, transported in ice and stored at -10 °C till analysis. Analysis was done on day 0, 7, 14, 21 and 28. Three fish were analyzed on each day in triplicate from each. The experiment was carried out twice. MDA content in stored tilapia was analyzed using TBA (Thiobarbituric Acid) test and SSP content was analyzed by the method of Munasinghe *et al* (2003). A homogenate of fish muscle: distilled water at 1:10 was used to measure pH. The MDA content did not show any regular increasing or decreasing pattern. However there was an overall increase by day 28 (1.14 mg/ kg) in MDA content compared with the initial value (0.252 mg/ kg). There was a difference in the pattern of variation of MDA between the 1st and the 2nd experiments, probably due to the variations in food sources since the fishes were obtained from two different seasons of the year for the two experiments. Though there was an increment in the MDA value, it did not surpass the highest acceptable level for consumption (4.5 mg/ kg). The reduction of SSP between day 0 (0.338 mg/ g) and Day 21 (0.13 mg/ g) and Day 28 (0.098 mg/ g) found to be significant ($P < 0.05$). This shows that even at -10°C storage, the quality of protein is affected. The pH of the fish also increases from 6.801 to 7.352 during the 28-day storage period indicating intense microbial activity. This indicates that even at -10 °C the quality of protein deteriorates and the microbial activity increases. Yet the MDA level did not surpass the highest acceptable level for consumption indicating that the fish stored at -10°C do not have adverse effects of lipid peroxidation.

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COMPARISON OF THE ANTIOXIDANT ACTIVITIES OF SOXHLET EXTRACTS OF SRI LANKAN BLACK, GREEN AND “FACTORY DISCARDED” TEA

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Tea is the second most popular beverage in the world, next to water. From the total amount of teas produced and consumed in the world, 78% accounts for black tea and 20% accounts for green tea. “Factory discarded” tea is a wastage of black tea production. Although extensive research work has been carried out on the antioxidant properties of teas, Sri Lanka is still far behind. Comparison of black vs green tea is never carried out in Sri Lanka. Therefore, the objective of the present research was to compare the antioxidant activity of Sri Lankan black vs green vs “factory discarded” teas using *in vitro* antioxidant assays. Sequential Soxhlet extracts of each BOP black (B), fanning’s green (G) and “factory discarded” (FD) tea samples in hexane, chloroform, dichloromethane, ethyl acetate and methanol were tested using ferric reducing antioxidant power (FRAP), 2,2-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), oxygen radical absorbance capacity (ORAC) and 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assays. Results of each assay were expressed as milligram trolox equivalent per gram of tea extract (mg TE/g). According to the FRAP assay hexane (233.27), chloroform (384.27), dichloromethane (84.53) and methanol (470.13) extracts of G and ethyl acetate extract of B (432.53) had the best activities. Hexane (973.56) and chloroform (627.44) extracts of G, dichloromethane extract of FD, ethyl acetate (1353.41) and methanol (3549.98) extracts of B had the best activities for the ABTS assay. Hexane (398.69, 37.94), dichloromethane (2840.61, 220.18) extract of G, chloroform (353.61, 28.72), methanol (19179.12, 94.32) extract of FD and ethyl acetate (4958.58, 192.09) extract of B had the best activities for the DPPH and ORAC assays respectively. G had the highest antioxidant activities from similar extracts of different teas for four (FRAP), two (ABTS), two (DPPH) and two (ORAC) out of five tested extracts. Ethyl acetate extracts of B according to the four assays and methanol extract (ABTS) obtained the highest antioxidant activities from similar extracts of different tea types. ABTS (dichloromethane), DPPH (chloroform, methanol), ORAC (chloroform, methanol) assays results of FD had the highest antioxidant activities from three tea types. Polar compounds may be responsible for antioxidant activities of tea than the non-polar compounds. Results of the different assays had different activities for the same extracts (e.g. G-Methanol; FRAP- 375.87, ABTS- 3549.98, ORAC- 83.16, DPPH- 4306.79). This may be due to the different mechanisms involved in each assay.

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LIPID CONTENT AND FATTY ACID PROFILE OF EDIBLE OYSTER *CRASSOSTREA MADRASENSIS* IN PUTTALAM LAGOON; SRI LANKA

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Oyster fishery is one of the emerging small-scale fishery among poor coastal communities in Sri Lanka. However, oysters are highly esteemed seafood and considered a delicacy throughout the world, as they constitute a rich source of many of the elements, essential for providing a balanced diet. Nutrition content of bivalves can be changed according to their habitat. There is no known study was done on nutritional value of oysters grown in Puttlam lagoon in Sri Lanka. In order to establish this fishery, it is important to study on nutritional composition of oysters that is currently known only as a source of protein. Thus the aim of the present study was to investigate the lipid composition and fatty acid profile of edible oyster, *Crassostrea madrasensis* collected from Gangewadiya area in Puttlam lagoon. Samples were collected from July to September 2014 and lipid content was determined according to Bligh & Dyer method. Fatty acids profile of oysters was identified by gas chromatography. The content of total lipid of muscles of oyster was $1.61 \pm 0.53\%$. For the fatty acid composition, saturated fatty acids had the greatest content (25.07%), followed by monounsaturated fatty acids (19.52%) and polyunsaturated fatty acids (PUFA) (16.80%). The predominant fatty acids were palmitic acid (16:0) ($18.12 \pm 6.18\%$), C22:1 (n-9) ($9.66 \pm 3.33\%$), Docosahexaenoic acid (C22:6 (n-3)) ($6.60 \pm 2.95\%$). Stearic acid (C18:0), Oleic acid C18:1 (n-7), Arachidonic acid (C20:4 (n-6)) and Eicosapentaenoic acid (C20:5 (n-3)) also contained in considerable amount (2.0-5.0%) in oysters grown in Puttlam lagoon. The n-3/n-6 index was 2.97, which shows the occurrence of a high proportion of n-3 PUFA over n-6 PUFA in *C. madrasensis*. This study demonstrated that this species was characterized by low fat content ($\leq 2.0\%$) and also being a good source of docosahexaenoic (22:6n-3, DHA) and eicosapentaenoic (20:5n-3, EPA) fatty acids. Therefore, *C. madrasensis*, in terms of lipid and fatty acids, could be recommended for human consumption.

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INFLUENCE OF AGE ON PHYSICAL FITNESS FACTORS OF SCHOOL BADMINTON PLAYERS

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World federation defines any person playing badminton as a badminton player. Previous research suggested that the relative age effect (RAE) has a psychological influence on children and their decision to engage in a particular sport. Cross sectional observational study was done to determine whether age of players has any influence on physical fitness factors of school badminton players.

One hundred and eighty three school badminton players, age between 9 to 15 years, who were on a proper regular training were included in the study. Handgrip, Sit and reach test, shoulder flexibility test, push ups test, standing long jump test, 20m sprint speed test, agility T-test and 20m multistage shuttle run test were performed to measure upper body power, flexibility of lower back and hamstrings, flexibility of shoulders, upper body strength and endurance, explosive power of lower limbs, speed, agility, and aerobic endurance, respectively. Linear regression was performed between the age of the players and their physical fitness parameters using SPSS software.

The present study revealed that with increasing age of the players, upper body power, explosive power of lower limbs, agility and speed increased. But flexibility of the lower back and hamstrings were not influenced by the age of players. The study concluded that physical fitness factors of school badminton players improve with age when players are on a proper, regular training.

THE EFFECT OF INVOLVEMENT IN OTHER SPORTS ACTIVITIES ON THE PERFORMANCE OF SCHOOL BADMINTON PLAYERS

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Badminton is one of the popular games among the schools in the Kandy district, which serve as an informal educational context, helping the child to develop positive values and healthy habits. The aim of this study was to investigate the benefits of additional sports involvement on the performance badminton players.

Eight Physical fitness factor of 183 school badminton players, age between 9 to 15 years were measured using standardized testing protocol (Australian National Junior Programme Protocol) by trained investigators. Handgrip was measured on school badminton players of Kandy district. Sit and reach test, shoulder flexibility test, standing long jump test, 20m sprint speed test, agility T-test and 20m multistage shuttle run test were performed. Linear regression was performed between the duration of additional sports involvement and the level of each physical fitness parameter.

Additional sports involvement did not affect any of the physical fitness parameters except the speed and ability of male badminton players, which were, in fact, decreased. It was observed that involvement in other sports does not give an added advantage to badminton players to improve their performance.

DIFFERENT CULTURAL PRACTICES AND HEALTH SEEKING BEHAVIOURS ASSOCIATED WITH VAGINAL DISCHARGE

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Vaginal discharge is a distressing, embarrassing symptom and a common gynaecological complaint among women in the reproductive age group. The most common pathological cause for vaginal discharge is reproductive tract infections, including sexually transmitted infections (STIs) and non STIs. Other causes include genital tract malignancy, fistulae, allergic reactions and atrophic vaginitis associated with menopause. Delayed treatment of reproductive tract infections can cause serious effects such as infertility, ectopic pregnancy and cervical cancer. However, health problems associated with sexual behaviours and reproductive health is often influenced by sociocultural factors, thus leading to delays in treatment. It is pertinent to differentiate a physiological discharge from a pathological vaginal discharge in order to prevent complications of untreated reproductive tract infections and to detect genital tract malignancies early. This descriptive qualitative study was carried out to assess different cultural practices and health seeking behaviours associated with vaginal discharge among females aged 18 to 49 years living in socially marginalized communities in the Colombo District. Three focus group discussions (FGDs) were conducted in an urban slum community, with women who had a previous history of vaginal discharge. Data were collected from February to March 2015. A total of 23 women, including all ethnic and religious groups, attended. FGDs were audio recorded and a note taker took field notes. The length of the FGDs varied from 45 to 90 minutes. Ethical clearance was obtained from the Ethics Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura (USJP). Verbatim transcripts were analyzed on the basis of qualitative content analysis. A majority of the participants were educated up to O/L (56.5%) and married (95.7%). Sixty one percent of participants had an extended family type. The mean age of the participants was 35.87 years (SD±7.02). A majority of the participants expressed the opinion that body heat and hot foods are the main reasons for vaginal discharge. A few participants attributed infections (bacterial, viral and fungus) and poor personal hygiene as the causes of discharge. The more typical pattern of health seeking was medical consultation after a variety of other options had been tried. Home remedies used to manage excessive vaginal discharge in this given community were polpala herbal drink, boiled cumin (suduru) drink, fenugreek (uluhal) drink, king coconut (thembili.), sago (sauw) kanji, hot water with powdered cloves (karabunati). Four themes emerged from the data namely, confusion in differentiating normality of vaginal discharge, disturbances created in daily life, confusion about the causation and cultural influences. These findings have important implications towards management of reproductive health problems. Primary Health Workers may use vaginal discharges in particular as a risk marker for identification of STIs. Educational programmes should target the misconceptions that exist in the communities/ local context related to the prevention, treatment and control of vaginal discharge and STIs in primary care settings.

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KNOWLEDGE AND DISTRIBUTION OF RISK FACTORS OF OSTEOPOROSIS AMONG FEMALE UNDERGRADUATES IN UNIVERSITY OF PERADENIYA

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Osteoporosis is a leading cause for fractures and disability. The most important risk factors are age, female sex, age at menopause, family history of osteoporosis, lack of exercise, calcium deficiency and low body mass index (BMI). Osteoporosis can be prevented if adequate calcium intake and adequate physical activity is maintained. The objective of this study was to assess the knowledge on osteoporosis and distribution of risk factors of osteoporosis among female undergraduates.

A cross sectional study was conducted among 293 female students in the second year. The participants were randomly selected from the Faculties of Arts, Science, Engineering and Agriculture of the University of Peradeniya. The probability-proportional-to-size method was applied to determine the number of students to be included from each faculty. All participants gave written informed consent to participate in the study. Data was collected using a self-administered questionnaire. A food frequency questionnaire, which took the portion size into consideration, was used to determine the calcium intake. Height and weight was measured to calculate BMI.

The mean age of the study population was 22 years. Of the study population 61.7% (95% C.I.= 60.2-63.0) had an adequate knowledge regarding risk factors and prevention of osteoporosis. A significant percentage of girls from the Faculty of Science (80.7%) had a better knowledge on osteoporosis compared to students from the Faculties of Arts (52.02%), Engineering (76.2%) and Agriculture (61.6%) ($p < 0.001$). Almost 29% (95% C.I.=24.3-33.1) had a low BMI (< 18.5). Approximately 78% of the population did not engage in recommended type and duration of exercise needed to prevent osteoporosis. The observed difference in the adequacy of exercise showed no statically significant difference between Faculties ($p = 0.43$). The daily calcium intake was below the minimum daily calcium requirement in 59.9% of the total population. There was no statistically significant difference in calcium intake between the Faculties ($p = 0.57$). Although 98% of the girls were aware that low calcium intake is a risk factor for osteoporosis, only 40% knew that the low BMI is a risk factor. Of the study population 6.6% had a family member diagnosed with osteoporosis.

Although there was a significant difference in knowledge on osteoporosis between Faculties, there was no significant difference in their life style such as calcium intake and exercise to prevent osteoporosis. Students of the Science Faculty may have had a better knowledge on osteoporosis due to their curriculum, which includes provision of knowledge on basic sciences and common diseases. There is a need to promote a healthy lifestyle among undergraduates in order to prevent osteoporosis in their later life.

VIDEO MOTION ANALYSIS OF THE STARTUP IN SPRINTERS

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Video Motion Analysis (VMA) is a resource used in sports in order to observe and improve sports technique. Sprinting is one of the most popular sporting events in the Sri Lankan University system. The start up in a sprinting event only takes a few milliseconds, where swift changes occur in the athletes biomechanics and observation with the unaided eye is insufficient to identify these changes. VMA is one available technology that can identify such subtle changes. Even though this technology is widely available, the athletic team at University of Peradeniya does not incorporate VMA into their sporting activities. This study aims to introduce and incorporate VMA into the Peradeniya University athletics team.

Thirty eight athletes participated in this study and a 3.2 megapixel camera was used to capture videos of the sprint startup of these athletes. The videos were analyzed with “Kinovea 0.8.15 open source software. The knee angles of the front and rear foot at the maximum height of the set position was calculated and compared with Standard Olympic values. Errors were detected by the investigator and the team coach and thereafter for a three month period, regular VMA aided training sessions were carried out in order to correct the detected alterations. Post training videos were taken and reanalyzed using the same software and compared with the pre training videos. The team coach assessed each video and detected the errors in knee angles and helped the athletes to adjust the knee angles during practice sessions.

Front foot knee angle values of the athletes were 88.19-95.22 degrees in 95% confident interval, rear foot knee angle values were 103.38-111.71 degrees with 95% confidence interval. A paired t test was conducted on the pre and post training values. Statistical analysis conveys that VMA helped to correct knee angle of front foot and rear foot of the set position in the athletes.

In conclusion incorporating VMA technology to the Peradeniya University athletic team has helped them to improve the knee angles at the set position at startup of sprinting.

A RARE VARIATION OF THE LEFT RENAL VEIN

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Small veins of renal segments communicate with one another to subsequently form 5 or 6 interlobar veins that unite at the hilum to form a single left renal vein. Usually the vein is placed ventrally to the corresponding left renal artery, at the hilum. It drains into the inferior vena cava at a right angle, at the level of L2 vertebra. The left renal vein is usually three times the length of the corresponding right renal vein (around 7.5 cm against 2.5 cm). This is due to the fact that the left renal vein runs across the abdominal aorta ventral to it, and immediately below the origin of the superior mesenteric artery, to drain into the inferior vena cava. It acts as a common vessel of drainage on the left side, typically receiving the left gonadal vein, left suprarenal vein, and often than not, a left inferior phrenic vein. In contrast, the right renal vein drains only the right kidney. Reported variations of the left renal vein include, accessory renal vein, retro-aortic or circum-aortic position and supernumerary veins. The complex nature of drainage reported in this case does not seem to be documented in previous literature.

Variations in the anatomy of the left renal vein were observed, in an elderly female cadaver during routine dissections at Faculty of Medicine, University of Peradeniya. Abdominal viscera and fascia were methodically removed to reflect the posterior abdominal wall from an anterior aspect view. The right renal vein and both renal arteries were also observed for variations. Lengths of both veins were measured.

There were two prominent tributaries outside the hilum of the left kidney uniting to form the left renal vein. These tributaries were dorsal to the left renal artery. The left kidney was not ectopic or malformed. A left inferior phrenic vein joined the left suprarenal vein 2-3 cm below its origin, subsequently draining into the left renal vein. The left gonadal vein draining into the left renal vein was also noted. In addition another vein emerging from the posterior abdominal wall below T12 and L1 vertebral bodies, were observed to join and drain through a common stem into the left renal vein in close proximity to the point the left suprarenal vein drains. From this point the left renal vein was observed to run infero medially in an oblique course to drain into the inferior vena cava as low down as the level of the aortic bifurcation; in this specimen the upper border of the L4 segment. The vein joined the inferior vena cava approximately at an angle of 60 degrees clockwise. No other variation in the same vein was observed. There were no variations in the right renal vein or renal arteries on either side. The length of the left and the right renal veins were 11.8 cm and 3.2 cm, respectively. Hence, this combination deviates from the usual finding of a left renal vein being three times the length of the right renal vein. In this cadaver both renal veins were longer than the normal range of values.

As clinical implications, during resection of aortic aneurysms, left renal vein may need to be ligated, provided that it is done to the right of the point of entry of the gonadal and suprarenal veins. In addition, variations in renal vascular anatomy are important during management of renal trauma, renal vascular hypertension, renal transplants, nephrectomy etc. Veins being highly susceptible to trauma, preoperative recognition of such anomalies in the renal vasculature are of great importance for surgeons to ensure haemostatic control during posterior abdominal/renal procedures. Renal transplants too are a common surgical intervention where renal veins are manipulated to a greater extent.

RENAL DISEASE PATTERN IN A SAMPLE OF SRI LANKAN ADOLESCENTS UNDERGOING RENAL BIOPSY

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The prevalence of renal disease types varies with age and the prevalence patterns among children and adults are well known. However, the renal disease profile during adolescence has not been well studied. Accordingly, we conducted the following study to assess the renal disease prevalence pattern in a sample of Sri Lankan adolescents undergoing renal biopsy.

A retrospective study of 307 individuals aged 10 to 20 years, who underwent renal biopsy at Teaching Hospital Kandy, from December 2011 to May 2015 was done. Clinical disease was classified as nephrotic syndrome, nephritic syndrome and others. All biopsies were evaluated with haematoxylin and eosin and silver stain and immunofluorescence for IgG, IgA, IgM and compliment 3. Electron microscopy was not performed. Hence, in those with nephrotic syndrome, the diagnosis of minimal change disease was made based on normal renal histology and negative immunofluorescence in adequate samples.

There were 263 (85.7%) subjects with glomerular diseases, 19 (6.2%) with tubulointerstitial diseases and the rest had inconclusive diagnosis. Overall, the most common renal diseases in this group with gender distribution were as follows, minimal change disease 63 (20.5%), 35 males (55.6%); lupus nephritis 49 (16%), 42 (85.7%) females; IgA nephropathy 21 (6.8%), 12 (57%) males; acute diffuse proliferative glomerulonephritis (ADPGN) 28 (9.1%), 19 (67.9%) males, and focal segmental glomerulosclerosis (FSGS) 26 (8.5%), 14 (53.8%) males. Clinically, 144 had nephrotic syndrome, 86 had nephritic syndrome and 77 had other presentation patterns. The common renal diseases among nephrotic syndrome patients were, minimal change disease 55 (38.2%), FSGS 21 (14.6%), lupus nephritis 8 (5.5%) and membranoproliferative glomerulonephritis 6 (4.2%). The common renal diseases among the nephritic syndrome group were, lupus nephritis 22 (25.6%), ADPGN 15 (17.4%), IgA nephropathy 12 (14%) and Henoch-Schonlein purpura 6 (7%). The renal diseases among the other presentation patterns varied widely and the most common types were, lupus nephritis 15 (19.5%) and ADPGN 7 (9.1%).

Worldwide, during childhood, minimal change disease is the commonest cause for nephrotic syndrome and ADPGN for nephritic syndrome; the other renal diseases are less common. FSGS and minimal change disease are common causes of nephrotic syndrome in young adults and diabetic nephropathy in older individuals. IgA nephropathy and lupus nephritis are the two most common causes of nephritic syndrome among adults. Overall IgA nephropathy is the commonest primary renal disease among adults. In the present adolescent study group, the common primary renal diseases are minimal change disease followed by IgA nephropathy demonstrating a transitional pattern from childhood to adulthood. Similarly, the renal disease prevalence patterns in nephrotic syndrome and nephritic syndrome also demonstrated a transitional pattern. Overall, lupus nephritis was the commonest renal disease type among adolescent females and minimal change among males.

KNOWLEDGE AND PERCEPTIONS ON CANCER PALLIATIVE CARE AMONG SRI LANKAN NURSES: A QUALITATIVE STUDY

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The Majority of cancer patients worldwide are in advanced stages of cancer when they come to hospital. At this stage pain relief and palliative care is the only realistic treatment options. Qualitative study design was employed to explore the knowledge and perceptions on needs of nursing personnel with regards to adult cancer patients they are caring for, in the selected institutions. Participants were recruited purposively from National Institute of Cancer Maharagama (NICM), Shantha Sevana Hospice (SSH), Cancer Home (CH) and Ceylinco Oncology Unit (COU). In-depth interviews and Focus Group Discussions (FGDs) were conducted. Trustworthiness of the qualitative study was maintained. Max Van Manen's Phenomenological approach was followed to analyze qualitative data and thematic analysis was performed.

Sample consists of 15(43%) participants for in-depth interviews and 20(57%) participants for FGDs. 13.3% male and 86.7% female nurses. The average age was 35years which ranging from 26 and 50 years. The average experience as a nursing profession was 4 years. None of the nurses had received special training on cancer palliative care prior to the period of intervention.

The key themes identified after analysing both in-depth interviews and FGDs with nurses were 1) desire for continuing education, 2) being stressful, and concerns about raising the quality of care in the face of limited staffing, 3) concerns about implementation of holistic approach and 4) try to be happy.

Participants of the current study were of the view that they need to be adequately knowledgeable to provide quality palliative care and to educate the patients. Nurses identified the heavy workload and the time constraint as barriers to improve the knowledge.

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FACTORS INFLUENCING THE PHYSICAL INACTIVITY AMONG HIGH SCHOOL STUDENTS IN THE DISTRICT OF JAFFNA, SRI LANKA

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Regular physical activity remains an important behavior for preventing Non Communicable Diseases (NCDs). The period of adolescence represents the transition from childhood to adulthood and lifetime habits such as regular physical activity are normally begun at this time. But unfortunately, research has indicated that physical activity rates decline consistently during the adolescent years. This study aimed at examining physical activity level of adolescents and their perceived barriers. Adolescents students (n = 182) were recruited for the study. Current physical activity level and perceived barriers to physical activity were assessed in the sample. Physical activity level was estimated by IPAQ short version (International Physical Activity Questionnaire). Using a Likert Type scale, participants responded to an instrument with 21 items representing 07 barriers to physical activity. Sum scores were computed. Lack of time, social influence, lack of will power and fear of injury were mentioned as the main barriers to perform the physical activity by more than 50% of study subjects. Physical inactivity showed a significant relationship with lack of time (p=0.021) and social influence (p=0.041) whereas no significant relationships were found (p>0.05) with other factors such as lack of will power, lack of energy, fear of injury, lack of skill and lack of resources. There is a need for future research that needs to be carried out with larger sample groups to develop a national standardized instrument. It will be helpful for accurately identify perceived barriers and to recommend changes to enhance physical activity among adolescents.

RELATIONSHIP BETWEEN RANGE OF LUMBAR FLEXION AND EXTENSION WITH GENDER AND ANTHROPOMETRIC MEASUREMENTS OF HEALTHY YOUNG UNDERGRADUATE STUDENTS WHO DO NOT ENGAGE IN REGULAR PHYSICAL TRAINING: A STUDY CONDUCTED IN UNIVERSITY OF PERADENIYA, SRI LANKA

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Flexibility of lumbar spine is important in facilitating activities of daily living, posture control and the maintenance of the stability of spinal column. Flexibility is described in terms of range of motion which is influenced by factors such as size and composition of the body, sex of the individual etc. Restricted lumbar range of motion increases the risk of sustaining injuries and related pathologies. As such understanding these aspects of populations that are inclining towards sedentary life styles would help in implementing strategies to improve their quality of life. Present study describes the association of range of lumbar flexion and extension with sex, height, weight, Body Mass Index (BMI), waist circumference (WC), hip circumference (HC), and Waist to Hip Ratio (WHR) among healthy, residential undergraduates of University of Peradeniya Sri Lanka, who are not engaged in regular physical training.

A total of 360 students were selected randomly with equal distribution of sex and measurements related to anthropometric variables were taken in duplication using standard equipment and standard techniques. Modified-Modified Schober Technique was used in measuring lumbar range of motion.

Lumbar flexion and extension for all participants were 5.85±1.13 cm and 2.67±1.0 cm. Males had a significantly higher flexion than that of the females (6.14±1.06 cm Vs. 5.56±1.1 cm, P=0.0001). Females had a significantly higher extension than that of the males (3.01±1.22 cm Vs. 2.33±0.64 cm, P=0.0001). Mean BMI too was significantly higher among males than that of the females (22.59±3.88 cm Vs. 20.49±3.38 cm). Lumbar flexion of male students had a significant positive correlation with height (P=0.0387), weight (P=0.0001), BMI (P=0.0001), WC (P=0.0001), HC (P=0.0001) and WHR (P=0.0003). Lumbar extension of them decreased significantly with increasing weight (P=0.0201), BMI (P=0.0308), WC (P=0.0007), HC (P=0.0046) and WHR (P=0.0145). Lumbar extension of female students increased significantly with increasing weight (P=0.0001), BMI (P=0.0001), WC (P=0.0240) and HC (P=0.0079).

Reduction in lumbar extension which increased with the body size and composition and the inclination towards overweight seen among male undergraduates who are not engaged in regular physical training is note worthy as they are at risk of developing pathologies and injuries related to these problems. This necessitates the implementation of preventive strategies for them. The differences in the anthropometric values and trends observed between males and females indicate the requirement of separate normative values for populations represented by them.

STUDY ON IMPACT OF ANATOMICAL LOCATION OF RENAL STONES ON MECHANISM OF NUCLEATION AND GROWTH IN SRI LANKAN POPULATION

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Renal calculi are one of the major health issues in the urinary system, which causes a large health care burden. Although many therapeutic options have been developed for the treatments of renal stones, the mechanism of formation of renal stones still remains controversial. In order to interpret the genesis and the growth of stones in different anatomical locations in the renal system, we examined 76 renal stone samples in different anatomical locations collected from Teaching Hospital, Peradeniya, Sri Lanka.

Visual and microscopic analyses of the surface and cross sections of samples were carried out by optical means. Also the chemical characterization of them was carried out by X-ray Fluorescence (XRF) Spectroscopy.

The results revealed that organic matter initiate the nucleation of the renal stone. And nucleation is the first step of formation of renal calculi. Fragments of early formed stones within the pelvicalyceal system can also be the nuclei of stones in other anatomical locations. Nucleus and periphery zones have characteristically different lamination patterns. Morphological and chemical data indicate significant differences between nucleus and the periphery of renal stones. It clearly shows that the formation of nucleus and the growth of periphery zones of stones are governed by different processes. Further, renal stones can be characterized by their origin and the growth. Therefore the identification of the anatomical location and the formation of the renal stone is likely to be useful to determine the most appropriate treatment.

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EFFECTS OF AEROBIC TRAINING (AT) AND RESISTANCE TRAINING (RT) ON BODY COMPOSITION OF FIRST YEAR FEMALE STUDENTS IN THE UNIVERSITY OF PERADENIYA

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Worldwide, at least 2.8 million people die each year as a result of being overweight or obese. In all WHO regions, women were more likely to be obese than Men. According to the Sri Lanka Journal of Diabetes, Endocrinology and Metabolism in 2012, 22.8% are overweight and 6.6% are obese among non-pregnant and non-lactating Sri Lankan women aged 15-49 years. Physical inactivity leads to get non-communicable diseases and affects body composition and person's external appearance. Health care authorities may not be aware of whether the younger generation of this country is at a risk of having major health issues or not, since there is lack of reliable scientific data or studies. This study educated the students regarding future health problems resulting from lack of physical exercise before they come across those matters. This study revealed the most effective way of doing physical exercises which is useful in people who have problems in body composition or prone to such problems. With that awareness university students will be motivated to avoid a sedentary life style & persuade to use free time to do physical exercise.

Participants of this study were randomized to either AT (n=61) or RT (n =61) for 6 weeks. Following medical screening, 122 subjects were measured skin fold thickness, Body Mass Index (BMI), girth measurements, Waist: Hip ratio and Bioelectrical Impedance, strength and aerobic capacity testing. VO₂ max was evaluated using one mile walk test and strength was evaluated using 12 repetition-maximum (12RM) test. Progressive exercise programs (AT, 30-60 min aerobic dancing at 60%-75% maximal heart rate; RT, 3-2 sets × 8-10 repetitions of 8-12 exercises at 60%-80% of 12RM) were conducted.

The results showed that total body fat mass% measured using BIA method is significantly reduced (P< 0.05) in both groups and AT group shows significant decrease (P<0.05) of this variable comparatively to the RT. BMI values are not showing any significant difference (P>0.05) in both groups. Though waist and hip values separately has significant reduction (P<0.05) in AT group and no significant difference (P>0.05) in RT group, Waist: Hip ratio has no any significant difference (p >0.05) regarding both exercise programs. The total body fat mass calculated by Skin Fold Thickness (SFT) has reduced significantly (P<0.05) in AT group and the RT group shows no significant difference (P>0.05). AT group has significant reduction (P<0.05) in Abdominal circumference (AC), Arm, Thigh girth measurements while RT group has no Significant reduction (P>0.05). Significant increase (p<0.05) was seen in VO₂ max in AT group after exercise program. The 12 repetition maximum value of the RT group after exercise has significantly increased (P<0.05).

AT has more effect on reducing total body fat mass while RT has less effect on total fat mass reduction. AT has significant improvement of aerobic endurance capacity and RT has significant improvement in strength.

ECTOPARASITES (TICKS AND FLEAS) OF SMALL MAMMALS (MURINE RODENTS AND SHREWS) FROM SELECTED SITES IN KURUNEGALA AND KANDY DISTRICTS

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Ticks and fleas are medically important ectoparasites and 35 species of ticks and 20 species of fleas have been reported from Sri Lanka. Of these, five species of ticks and 11 species of fleas were reported from small mammals. Present study reports the species of ticks and fleas infesting murine rodents and shrews collected from 17 selected sites in Kurunegala and Kandy Districts. Ticks and fleas were identified using taxonomic keys.

A total of 131 small mammals were trapped from Kurunegala: *Rattus rattus* (98), *Bandicota indica* (9), *B. bengalensis* (7), *Mus cervicolor* (4), *M. musculus* (2) and *Suncus murinus* (11). From which 25.9% (34/131) were infested with either ticks (20.6%) or fleas (5.3%), but none had mixed infestations. A total of 155 small mammals were trapped from Kandy: *R. rattus* (99), *M. cervicolor* (17), *M. fernandoni* (14), *M. musculus* (3), *B. indica* (7), *B. bengalensis* (6), *Golunda ellioti* (3), and *S. murinus* (6). From which 33.5% (52/155) were infested with ticks (14.2%), fleas (18.0%) or both (1.3%). Two species of ticks (*Rhipicephalus haemaphysaloides* 25/34 and *Haemaphysalis spinigera* 1/34), a *Haemaphysalis* larva and a flea (*Xenopsylla cheopes* 7/34) were recorded from *R. rattus*, *B. indica* and *S. murinus* in Kurunegala. *Rattus rattus* (25/98) were infested with *R. haemaphysaloides* and *X. cheopes*. *Bandicota indica* (3/9) were infested with *R. haemaphysaloides*, and *S. murinus* (6/11) with *R. haemaphysaloides*, *H. spinigera* and a *Haemaphysalis* larva. Four species of ticks (*R. Haemaphysaloides* 15/52, *H. spinigera* 4/52, *I. ceylonensis* 4/52 and a *Dermacentor auratus* nymph 1/52), a *Haemaphysalis* larva and three species of fleas (*X. cheopes* 13/52, *Stivalius phoberus* 9/52 and *S. aporus* 11/52) were recorded from *R. rattus*, *M. cervicolor*, *M. fernandoni*, *B. indica* and *G. ellioti* collected from Kandy. *Rattus rattus* (37/99) were infested with four tick species (*R. haemaphysaloides*, *H. spinigera*, *I. ceylonensis* and *D. auratus*) and three flea species (*X. cheopes*, *S. phoberus* and *S. aporus*). A single individual of *M. cervicolor* (1/17) was infested with Larvae of *I. ceylonensis*. *Mus fernandoni* (10/14) were infested with *R. haemaphysaloides* and *S. aporus*. *Bandicota indica* (3/7) had *R. haemaphysaloides*, *H. spinigera* and a *Haemaphysalis* larva and *G. ellioti* (1/3) had *R. haemaphysaloides*. Mixed infestations of two tick species, two flea species or Tick and a flea species were recorded from seven *R. rattus* and one *M. fernandoni* in Kandy district. All the ticks found were immature stages except two adult females of *I. ceylonensis* found from Kandy.

All the species of parasites reported here have been previously recorded from Sri Lanka, but *D. auratus* and *H. spinigera* are reported for the first time from murine rodents. *Rhipicephalus haemaphysaloides* from *B. indica*, *G. ellioti* and *S. murinus*; *H. spinigera* from *B. indica* and *S. murinus*; *D. auratus* from *R. rattus*; larvae of *I. ceylonensis* from *M. cervicolor* are new host records for the country. Of the ectoparasite species reported here, *R. haemaphysaloides*, *Haemaphysalis spp.*, *D. auratus* and *X. cheopes* have been identified as vectors of *Rickettsia* spp. in other parts of the world, and *D. auratus* is reported to cause auto-acariasis in Sri Lanka. Hence this study is useful for future research on zoonotic diseases transmitted by shrews and rodents in the country.

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AWARENESS OF MENSTRUAL HYGIENE AMONG ADOLESCENT GIRLS IN THE KANDY EDUCATIONAL DIVISION

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Menstrual hygiene is a vital, as well as a very sensitive issue for women in reproductive ages. Having a safe, personal and cultural environment to manage menstruation hygienically and with dignity is the right of every woman.

Good hygienic practices such as the use of sanitary pads and adequate washing of the genital area are essential during menstruation.

The aim of this descriptive cross sectional study was to describe the awareness of menstrual hygiene among adolescent girls attending schools in urban and rural areas of the Kandy Educational Division. The sources of information, possible associations with socio-economic status, and the level of awareness and myths and misbeliefs with regard to menstrual hygiene were assessed using an open ended questionnaire. The study sample comprised of 400 students (230 urban, 170 rural).

The mean age of participants was 14.0 years. A majority of rural girls belonged to a low economic status (88.8%). Approximately 94.5% of girls had learnt about menstruation from their mother. Almost all the girls considered menstrual hygiene as being important. Sanitary pads were used by 88.2% of the selected girls. The practice of the use of clothes as absorbent material was reported among 50% of the subjects. They changed menstrual dressing about 2-3 times per day (78.5%), avoided reuse of sanitary pads (87%), and used soap to clean genital area (99.5%). Although the subjects had a fair knowledge of menstruation, they also had strong myths and misbeliefs about menstrual hygiene. Some such practices seemed to have a direct impact on the nutrition and health of the young girls.

Although a variety of factors are known to affect menstrual behaviors, geographical location and socio-economic status were found to be the most influential. Health education programs to provide more scientific information about healthy menstrual practices to adolescent girls, as well as mothers and teachers, are recommended.

IRRATIONAL USE OF ANTIBIOTICS AMONG FINAL YEAR UNDERGRADUATES OF FACULTY OF ALLIED HEALTH SCIENCES, UNIVERSITY OF PERADENIYA

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Antibiotics kill or inhibit the growth of bacteria and are powerful medications that fight against bacterial infections. The practice of inappropriate use of antibiotics is a common problem worldwide and that has become a global challenge due to resistance for human pathogens. There are few reports about the inappropriate use of antibiotics in Sri Lanka. However, there are no studies conducted about the irrational use of antibiotics which are self-prescribed and prescribed by doctors. Therefore, this current research was started with the aim to report about the irrational use of antibiotic practices among final year undergraduate students at Faculty of Allied Health Sciences (FAHS), University of Peradeniya (UoP).

This was a descriptive study. Pretested structured questionnaire was distributed among the final year undergraduate students in year 2012 at the Faculty of Allied Health Sciences, University of Peradeniya. This study mainly focused on two different practices; first part was on self-prescribed antibiotics usage and the second part was about how the same population used the antibiotics which was prescribed by the doctors. Collected data were entered into excel spread sheet and analyzed by using simple statistics and the results were presented as percentages. The results were based upon the data provided by 131 (95%) of final year undergraduate students.

The results showed for self-prescribing practices; the commonest symptom and the commonly used medicine were cough and cold (33%) and amoxicillin (63%) respectively. The research finding also highlights inappropriate use of antibiotic usage for authentic prescriptions. The commonest reason for them to self-prescribe antibiotics was simplicity of the illness (35%). Most of the final year undergraduates have gained knowledge about antibiotics from their academic references (35%) while a large proportion of them think that self-prescribing of antibiotics is completely unsafe (44%).

In conclusion, there is a need to ensure appropriate use of antibiotics among student population in the universities. Therefore, awareness on appropriate antibiotics usage and education about this practice is necessary for the success of the treatment and prevention of spreading bacterial resistance.

EFFECT OF GLYCAEMIC CONTROL ON SERUM CONCENTRATION OF THIOBARBITURIC ACID REACTIVE SUBSTANCE IN LONG TERM DIABETES MELLITUS PATIENTS

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Diabetes is one of the most common endocrine disorders characterized by hyperglycaemia, which is usually accompanied by increased production of free radicals or impaired antioxidant defenses resulting in increased oxidative stress. Thiobarbituric acid reactive substances (TBARS) are generated during oxidation of lipids by free radicals. Oxidative stress in diabetes mellitus can be measured by estimating TBARS. The purpose of this study was to determine TBARS concentration in controlled and uncontrolled long term diabetic patients and compare the values with apparently healthy individuals (controls) in the Sri Lankan population.

The study group comprised of 50 patients having diabetes mellitus for more than five years who were between the age of 20 - 65 years, and 30 controls. Ethical clearance was obtained from the Ethics committee, Postgraduate Institute of Science, University of Peradeniya. The HbA1c was measured using turbidimetric inhibition immunoassay. HbA1c less than 7% was considered as controlled and more than 7% as uncontrolled diabetes. TBARS concentration was measured using thiobarbituric acid reagent.

There was a significant positive correlation ($r=0.330$, $p<0.05$) between HbA1c and TBARS in patients. The mean HbA1c was 8.4% in patients ($n=50$) and 5.1% in controls ($n=30$) and the difference was highly significant ($p<0.001$). The mean HbA1c was 6.8% in controlled diabetics ($n=12$) and 8.9% in uncontrolled diabetic patients ($n=38$). HbA1c value was significantly ($p<0.001$) elevated in the uncontrolled diabetics when compared with the controlled diabetic patients. The mean TBARS concentration of 2.22 ± 1.58 $\mu\text{mol/L}$ was significantly ($p<0.001$) higher in patients than in controls (1.21 ± 0.60 $\mu\text{mol/L}$). The mean TBARS concentration was 2.33 ± 1.70 $\mu\text{mol/L}$ in uncontrolled diabetics and 1.88 ± 1.08 $\mu\text{mol/L}$ in controlled diabetic patients. TBARS concentration was significantly ($p<0.001$) higher in uncontrolled diabetics than in controls. The findings of this study indicate that there is increased oxidative stress in Sri Lankan patients with long term uncontrolled diabetes mellitus.

**DETERMINATION OF HYPOGLYCEMIC ACTIVITY OF THE LEAVES
OF *ADENANTHERA PAVONINA* (MADATIYA)
AN ANIMAL STUDY**

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Diabetes mellitus is the most common endocrine disorder in men and women and this is considered as the major public health problem of epidemic proportion. *Adenantha pavonina* L is an important medicinal plant belonging to *Adenantha* L Genus (family *Fabaceae*) and distributed over tropical and sub-tropical regions. Several researches have been done on *A. pavonina* on its various activities due to huge usage in traditional herbal medicine against a variety of diseases.

Objective of this study was to investigate *A. pavonina* for its hypoglycemic activity. In this study the effect of aqueous solution of leaves of *A. pavonina* on the blood glucose level of normal rats was evaluated. Ten adult male rats divided into two groups (test and control) of five animals. Test group was treated orally with 500 mg/kg/day of aqueous solution of leaves of *A. pavonina* and control group treated with distilled water over 14 days of period. After that oral glucose tolerance test (OGTT) was done to determine the glucose tolerance activity.

There were no statistically significant differences between the average fasting blood glucose concentrations in between control group and test group before the commencement of study and after 14 days of study period. The mean values of fasting blood glucose concentrations before the commencement of study and after 14 days of study period in control group was 114.8 mg/DL and 100.4 mg/DL and in test group was 113.4 mg/DL and 94.8 mg/DL, respectively. When considering the OGTT results; there was a significant decrease in blood glucose levels in the test group treated with aqueous solution of leaves of *A. pavonina* at time 30 minutes and 120 minutes after loading 2g/kg of glucose.

There was a significantly high glucose tolerance activity in the test group compared to the control group. The study showed that aqueous solution of leaves of *A. pavonina* has the capability of regulating blood glucose level. It can be concluded that aqueous solution of leaves of *A. pavonina* can be used as a potential hypoglycemic agent. Further animal studies are needed to determine the toxicity and also human studies are required to confirm the *in vivo* pharmacological activity and dosage confirmation.

GLYCAEMIC CONTROL AND ANTIOXIDANT STATUS IN PATIENTS WITH LONG TERM DIABETES MELLITUS

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The oxidative stress in diabetes mellitus (DM) is greatly increased due to prolonged exposure to glycaemia and impairment of the oxidant/antioxidant balance which leads to damage of cellular organelles and enzymes. Therefore maintenance of adequate antioxidant levels is essential to prevent or even manage a great number of diseases. Good glycaemic control is important for reduction of long-term complications of diabetes. The aim of the present study was to evaluate the effect of glycaemic control on antioxidant status in patients with long term DM. Total antioxidant capacity (TAC) and protein thiol (P-SH) has been assessed as antioxidant markers.

The study group comprised of 50 patients having DM for more than five years and between 20 - 65 years of age and 30 controls. Ethical clearance was obtained from the Ethics committee, Postgraduate Institute of Science, University of Peradeniya. The HbA1c was measured using turbidimetric inhibition immunoassay. HbA1c less than 7% was considered as controlled and more than 7% as uncontrolled diabetes. TAC of serum was estimated by the method of Benzie and Strain (1996). P-SH in serum was estimated with Ellman's reagent.

The mean TAC of 975.1 ± 163.4 $\mu\text{mol/L}$ was significantly ($p=0.008$) higher in controls than in patients (875.2 ± 144.2 $\mu\text{mol/L}$). The mean TAC was 908.7 ± 127.0 $\mu\text{mol/L}$ in controlled diabetics and 864.6 ± 149.2 $\mu\text{mol/L}$ in uncontrolled diabetic patients. TAC was significantly ($p=0.006$) higher in controls than in uncontrolled diabetics patients. The mean P-SH of 598.1 ± 49.2 $\mu\text{mol/L}$ was significantly ($p<0.001$) higher in controls than in patients (485.3 ± 60.1 $\mu\text{mol/L}$). The mean P-SH was 503.4 ± 51.9 $\mu\text{mol/L}$ in controlled diabetics and 479.6 ± 61.9 $\mu\text{mol/L}$ in uncontrolled diabetic patients. The P-SH was significantly ($p<0.001$) higher in controls than in controlled and uncontrolled diabetics patients. The study revealed evidence of decreased antioxidant status in Sri Lankan patients with long term uncontrolled DM.

DEVELOPMENT OF A BRIEF INVENTORY FOR QUALITY EVALUATION OF PANORAMIC RADIOGRAPHS

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Dental practitioners frequently rely on orthopantomograms (OPGs) in patient management as it has high clinical efficacy and visualize the entire dentition and related structures in one film. Conventional OPG systems are still used in Sri Lanka and adequate attention is not paid to quality assurance and quality control although large numbers of OPGs are taken every day. The objective of the present study was to develop and validate a brief quality assessment tool that can be used to evaluate conventional OPGs within a short period.

In phase 1 of the study, a modified version of the Korean criteria (MKC) was prepared for evaluation of conventional OPGs. Using the items in both MKC and standard criteria, a brief inventory (BI) was developed. The BI was evaluated by two radiologists and a senior lecturer in radiography for content and face validity and then pretested. In step I of the phase 2, quality of 30 OPGs made using the same conventional OPG machine was evaluated by 3 final-year student radiographers and one professional radiographer using both BI and MKC. The scores produced and the times taken for evaluations were recorded. In the step II, 3 OPGs (that received lowest marks in the step I) were evaluated by 12 final-year student radiographers using the same procedure. The SPSS software was used for analysis.

Experts were happy with the face validity and content validity of BI. Compared to MKC, BI had a sensitivity of 81% and specificity of 82%. Reliability analyses produced high Cronbach's Alpha for BI (0.99). Intra-class Correlation Coefficients (ICC) for BI was above 0.9 among different raters. The scores of MKC and BI produced by students ($r=0.92$) and radiographer ($r=0.91$) were highly correlated. The average time taken to use BI (1.2 ± 0.35 min) was significantly less ($P<0.001$) compared to that of MKC (4.3 ± 0.71 min). In the Step II, the scores produced by BI were highly reproducible with mean scores produced by 12 raters being 65.4 (95%CI: 64.78, 66.05), 57.8 (95%CI: 57.46, 58.04), 75.67 (95%CI: 75.35, 75.97) with coefficient of variations being 1.5%, 0.8% and 0.7% respectively.

It is reasonable to conclude that the BI is a quick and effective tool for quality evaluation of conventional OPGs with adequate internal consistency, reliability and reproducibility.

MICROALBUMINURIA AND ANTIOXIDANT STATUS IN LONG TERM DIABETES MELLITUS PATIENTS

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The prolonged survival of patients with diabetes mellitus (DM) has led to an increasing incidence of end-stage renal disease and diabetic nephropathy. DM is usually accompanied by increased production of free radicals or impaired antioxidant defenses resulting in increased oxidative stress. Oxidative stress can promote the development of complications of DM. Therefore maintenance of adequate antioxidant levels is essential to prevent or even manage a great number of diseases. The objective of the present study was to correlate microalbuminuria levels to antioxidant status in Sri Lankan patients of long term DM. Total antioxidant capacity (TAC) and protein thiol (P-SH) has been assessed as antioxidant markers.

The study group comprised of 50 patients who have had DM for more than five years, aged between 20 - 65 years, and 30 controls. Ethical clearance was obtained from the Ethics Committee, Postgraduate Institute of Science, University of Peradeniya. Urinary microalbumin was measured using immunoturbidimetric assay. The urinary creatinine concentration was measured by enzymatic method. Urine microalbumin to urine creatinine ratio of < 30 mg/g was consider as normoalbuminuria, 30-300 mg/g as microalbuminuria and > 300 mg/g as proteinuria. TAC of serum was estimated by the method of Benzie and Strain (1996). P-SH in serum was estimated with Ellman's reagent.

Significant negative correlations were observed between microalbuminuria and TAC ($r=-0.398$, $P<0.05$) and P-SH ($r=-0.286$, $P<0.05$) in patients. The mean TAC of 875.2 ± 144.2 $\mu\text{mol/L}$ was significantly ($p=0.008$) lower in patients ($n=50$) than in controls (975.1 ± 163.4 $\mu\text{mol/L}$; $n=30$). The mean TAC in normoalbuminurics, microalbuminurics and proteinuric patients was 943.5 ± 108 $\mu\text{mol/L}$, 783 ± 80.9 $\mu\text{mol/L}$, 612 ± 91.2 $\mu\text{mol/L}$ respectively. TAC was significantly lower in microalbuminurics ($p<0.001$) and proteinuric ($p<0.001$) patients than controls. The P-SH was significantly lower in the total patients, normoalbuminuric, microalbuminuric and proteinuric patients than the controls (485.3 ± 60.1 $\mu\text{mol/L}$, 492.3 ± 57.0 $\mu\text{mol/L}$, 401.5 ± 34.0 $\mu\text{mol/L}$, 375.0 ± 35.0 $\mu\text{mol/L}$ vs 598.1 ± 49.2 $\mu\text{mol/L}$, respectively; $p<0.001$). TAC ($p<0.001$) and P-SH ($p<0.05$) values were significantly lower in microalbuminuric patients than normoalbuminuric patients. TAC ($p<0.05$) and P-SH ($p<0.05$) values were significantly lower in proteinuric patients than normoalbuminuric patients. TAC ($p<0.05$) and P-SH ($p<0.05$) values were significantly lower in proteinuric patients than microalbuminuric patients. This study revealed that antioxidant status is depleted in patients with microalbuminuria compared to diabetic patients without microalbuminuria and this decrease was related to the microalbuminuria levels.

PILOT STUDY ON CHANGES IN SOME TRACE ELEMENTS IN LONG BONES IN OVARIECTOMIZED MICE

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Osteoporosis is a debilitating disease characterized by reduced bone mineral mass and altered bone micro architecture. To address the main challenges of this bone degenerative disease, it is important to reduce fracture risk, by improving bone quality, increasing bone mass, and promoting fast fracture healing. The involvement and the functions of trace elements such as Fe, Cu, Cr, Ni, Pb, Li, Mn, Zn and Co in bone metabolism are not yet clearly elucidated. Little is known about the relationship between trace elements and structural properties of bone. This information could probably be useful for prophylactic and therapeutic measures against osteoporosis.

The aim of this study was to quantitatively analyze the changes in Fe, Mg, Cu, Zn, K, Mn, Cd, Pb, Na, Cl, F and Co in the bone during development of osteoporosis by using an ovariectomy (OVX)-induced bone resorption (osteoporotic) model. Twenty-four 12-week-old female BALB/c mice were randomly divided into four groups (n=6). Two groups were subjected to the OVX-operation and the other two were subjected to a sham operation. An OVX-operated group and a sham-operated group were sacrificed on 'Day 0' and after three weeks and four weeks. The long bones were collected after sacrificing the animals, the bone marrow flushed out and one third of a long bone was dried and ashed at 550°C for 6 hours. For analysis of mineral content 5 mg of each ash sample was dissolved in 1ml of 3% HNO₃ solution. The mineral contents were determined by using the atomic absorption spectrophotometer with the graphite furnace.

The results indicated that there is a significant decrease in the Fe, Cu, Ni, and Mn contents of the long bones of OVX mice after four weeks of the surgery when compared to the animals that underwent a sham operation. This decrement was very significant with Fe, Cu, Ni and Mn (p value; Fe - 0.0012, Cu - 0.0001, Ni - 0.0001, Mn - < 0.0001).

These results indicate that certain trace elements such as Fe, Cu, Ni and Mn may be contributing to the development of osteoporosis, whereas some others such as Cr, Pb, Li, Zn and Co do not show such a significant contribution. Hence further studies are necessary to clarify the involvement of trace elements in the development of osteoporosis in ovariectomized mice.

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A COST EFFECTIVE FEASIBLE METHOD TO TRANSPORT DENGUE VIRAL NUCLEIC ACID IN AMBIENT TEMPERATURE FOR NEXT GENERATION SEQUENCING

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Although various diagnostic methods are available for the confirmation of dengue viral infections (DENV) in Sri Lanka, advanced genomic analysis techniques such as next generation sequencing (NGS) method still remains scarce. Since the DENV is a RNA virus, there is a need to transport either the DENV infected patient's samples or the extracted RNA samples to laboratories abroad for downstream evaluations such as NGS. RNA is labile and thus RNA samples should be preserved at -80°C to ensure the sample integrity. Shipping RNA samples is costly as the samples must be maintained in dry ice during shipment. The present study describes a cost effective and a feasible method to transport DENV nucleic acid for NGS. Though it is a generally used method for transporting DNA and cDNA, this method has not been used for the transport of DENV nucleic acid for downstream applications like NGS so far.

Total RNA was extracted (Qiagen, Cat No 5206) and converted to cDNA using random hexamers and M-MLV reverse transcriptase (Promega). Quantity and quality of cDNA was evaluated using Optizen Pop Bio Nanohandler before blotting. Known concentrations of cDNA samples were blotted onto a sterile Whatman filter paper and dried using the speed vac concentrator. The procedure was repeated at least three to four times to concentrate 40µl of cDNA on the filter paper. After drying, the filter papers containing cDNA were packed using sterile polythene, sealed and shipped in an envelope to the Virology Laboratory at the University of Calgary, Canada. After 5 days of shipment cDNA was eluted from the filter paper in 150µl of sterile water and the quantity and quality were tested using the Nano drop. One of the eluted cDNA samples was submitted for NGS resulting high quality sequences of DENV-1. This study demonstrates that this blotting method is an efficient and cost effective means of transporting DENV cDNA in ambient temperature for further analysis.

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AN ASSESSMENT OF PELVIC SURFACE DOSE DURING CHEST RADIOGRAPHY IN FEMALE PAEDIATRIC IMAGING

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Hundred chest X-ray examinations for female patients of pediatric age group (below 12 years) at X-ray room C in Kurunegala Teaching Hospital were studied. An electronic pocket dosimeter (PDM-112, E1418) 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 surface chest area was also measured. The correlations between the age, weight, height, Body Mass Index (BMI), peak kilo Voltage (kVp), milli Ampere seconds (mAs), thickness, distance, inverse square distance, against the ratio between scatter surface radiation dose to pelvic area and direct surface radiation dose were analyzed statistically using Pearson correlation. Correlations were considered as statistically significant at a P value of 0.05.

The accumulated pelvis surface radiation dose to all 100 patients was 83 μ Sv resulting in an average individual dose of 0.83 μ Sv. Average dose was even smaller than the least count of the electronic pocket dosimeter. The correlation was significant only with inverse square distance between lower margin of primary beam and sensitive area of the dosimeter. P value was 0.01. The P values for the patients' age were 0.982, the patients' weight 0.8492, the patients' height 0.607, the patients' BMI 0.447, kVp 0.108, mAs 0.098, the thickness 0.398, the distance between lower margin of the primary beam and the dosimeter 0.172.

ABUNDANCE AND DIVERSITY OF ANOPHELINE LARVAE IN RELATION TO PHYSICO-CHEMICAL PARAMETERS OF BREEDING HABITATS IN SELECTED SITES IN MANNAR, SRI LANKA

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The availability of breeding places and abundance and diversity of *Anopheles* larvae have significant influence on the adult mosquito population and dynamics of malaria transmission. Objective of this study was to examine breeding habitat diversity and quality of water for *Anopheles* mosquito diversity in Mannar District, in the Northern Province of Sri Lanka.

Three possible malaria sensitive (sentinel) sites (Mannar Town, Vankalai and Silawathura) in Mannar District were selected. *Anopheles* larvae and water samples were collected from permanent breeding places in these sentinel sites for 16 months period (April, 2013-July, 2014). Larvae were identified microscopically to species using taxonomic keys. Physico-chemical parameters such as temperature, Dissolved Oxygen (DO), pH, electrical conductivity, salinity, Total Dissolved Solids (TDS), turbidity and hardness of water in these breeding places were tested. Statistical correlation analysis and ANOVA were used to analyze the associations between physicochemical parameters and mosquito abundance.

A total of 2,160 water samples from 150 potential mosquito permanent breeding habitats were examined and categorized into 15 major breeding habitat categories as positive with the *Anopheles* larvae. Overall of 9,568 mosquito larvae belonging to the anopheline genus were found in 3 of the sites examined. These comprised of 07 species: *An. subpictus* (96.35%, n=9,219), *An. varuna* (1.47%, n=141), *An. peditaeniatus* (1.33%, n=127), *An. pallidus* (0.32%, n=31), *An. nigerrimus* (0.22%, n=21), *An. vagus* (0.18%, n=17) and *An. annularis* (0.13%, n=12). Although the main vector *An. culicifacies* was not recorded during study period but the secondary vector *An. subpictus* was recorded from all types of breeding habitats, indicating its capability of surviving in a broad array of environmental conditions and tolerance to a wide range physico-chemical parameter in different geographic locations. However, the abundance of *An. subpictus*, *An. varuna*, *An. peditaeniatus* and *An. barbirostris* showed significant positive correlation ($p < 0.05$) with conductivity, salinity, DO, TDS and turbidity. Temperature and pH were negatively correlated with larval abundance of *An. subpictus*, *An. nigerrimus* and *An. varuna* breeding in all habitats. However all physico-chemical parameters with other species did not correlate significantly ($p > 0.05$).

From this study strong correlations found between certain physico-chemical parameters and larval abundance, perhaps, confirms the influence of these parameters on the breeding activities of mosquitoes, and indicates the possibility of mosquito larval control through the manipulations of such parameters. These findings support insights in the development of integrated larval source management strategies suitable for the larval habitats present in the respective study sites.

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TNF- α AND IL-2 LEVELS IN DENGUE PATIENTS; CHANGES WITH CLINICAL PROFILES

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Dengue infection is endemic to tropical and subtropical regions of the world including Sri Lanka. The objective of the present study was to assess TNF- α and IL-2 responses in patients with dengue infection with varying clinical severity.

A commercially available cytokine ELISA kit was used to detect TNF- α and IL-2 in 67 patients confirmed with dengue (by RT-PCR and serology), 15 healthy controls and 6 blood culture positive typhoid patients. The 67 dengue patients consisted of 24 dengue fever (DF) patients and 43 dengue haemorrhagic fever (DHF) patients. Clinical data was collected with a help of a detailed questionnaire. A statistical test with p -value <0.05 was considered significant in mean comparison, or in correlation analysis.

No significant elevation in TNF- α levels was noted between DF and DHF patients (mean of DF=51.8 pg/ml, mean of DHF=96.2 pg/ml; $p=0.5$). However, a significant variation was observed in the IL-2 levels between DF and DHF (mean of DF=59.7 pg/ml, mean of DHF=166.9 pg/ml; $p=0.02$). No significant rise in TNF- α and IL-2 levels was noted with an increase in PCV ($>45\%$), thrombocytopenia, leucopenia and PCR positivity. The mean TNF- α and IL-2 values of DF and DHF were higher than that of healthy controls (mean TNF- α of healthy controls 20.72 pg/ml and mean IL-2 of healthy controls 27.49 pg/ml). A positive correlation was observed between the IL-2 and AST/ALT levels ($r=0.31$ and 0.28 respectively). A significant difference was noted in the IL-2 concentrations between DHF and typhoid patients ($p=0.005$). Moreover, a significant correlation was noted with the disease severity within different grades of DHF ($r=0.38$; $p=0.002$).

While both TNF- α and IL-2 are elevated in patients with dengue, TNF- α shows no significant association with the disease severity (DF and DHF) whereas IL-2 shows a positive correlation with the clinical severity in dengue virus infected DF/DHF patients ($P=0.02$). Furthermore, IL-2 showed a positive correlation with different grades of DHF ($r=0.38$; $p=0.002$). Absence of significant difference in TNF- α level might be due to the genetic polymorphisms in the TNF α gene in our study population. Higher levels of IL-2 at the early stages of symptomatic dengue infection might be used as a prognostic marker for the progression of DENV into severe conditions.

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GENOTYPIC VARIATION IN THE WHITE SPOT SYNDROME VIRUS ISOLATED FROM NORTH-WESTERN AND EASTERN PROVINCES IN SRI LANKA

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Shrimp farming in Sri Lanka has been identified as an economically important industry which earns about 70% of the total aquaculture exports of the country. However, the commercial farming of the black tiger shrimp (*Penaeus monodon*) is greatly affected by the disease caused by the white spot syndrome virus (WSSV) in this country. Identifying the genetic variation of this dreadful virus would enable to develop accurate diagnostic tools and to implement effective surveillance and control programmes. Although many studies were conducted in several countries to identify the genetic variations, there is no information available on the genetic variations of WSSV in Sri Lanka. The variable repeat regions in the ORF75, ORF94 and ORF125 of the WSSV genome have been used in the PCR based classification of WSSV isolates in many studies done elsewhere. The present study was intended to investigate the genomic variations of WSSV in North Western and Eastern provinces of Sri Lanka using the ORF 94 repeat region.

The brood-stock and post-larvae suspected to be infected with WSSV were collected from shrimp farms located in the North Western and Eastern provinces. Genomic DNA was extracted from the gills and pleopods of adult shrimps and from post larvae, and amplified by PCR using ORF 94 specific primers. Results of this study revealed that 11 (22%) out of 50 randomly collected shrimp samples were positive by PCR. Although there were three different sized (700bp, 800bp and 900bp) ORF 94 amplicons, no relationship was evident when comparing the patterns of amplicons with the different shrimp farming areas. Further, of the nine samples yielded 700bp sized ORF 94 amplicons, three randomly selected amplicons were sequenced. The alignment of the sequences of 700 bp amplicons with GenBank data using NCBI-BLAST revealed that the amplified fragments WSSV had 94% similarity with the ORF 94 of the WSSV strain DC 97. As the smaller sample size of this study precludes the determination of the extent of genetic variations of WSSV in Sri Lanka, further studies are needed on this aspect by expanding the study areas with increased sample size.

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MEASURING RADIATION DOSE TO THE HAND OF A NUCLEAR MEDICINE TECHNOLOGIST AT A SELECTED PRIVATE HOSPITAL

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This study was carried out to measure the radiation dose to the hands of a nuclear medicine technologist who handled ^{99m}Tc-labeled radiopharmaceuticals and ¹³¹I by using an electronic pocket dosimeter in a selected private hospital. Based on the results obtained from the study performed during three months the annual equivalent dose to the hands was estimated. The aim of the study was to determine if the equivalent dose is within recommended dose limits of the ICRP.

An electronic dosimeter was worn on the right wrist of the technologist in addition to his routinely used thermoluminescent dosimeters (TLD). Radiation doses to the hands were recorded on a daily basis. According to the factors such as number of procedures, type of procedure, radioactivity of the sodium pertechnetate eluate and the method of preparation of the radiopharmaceuticals the radiation dose varied. 599 nuclear medicine procedures were performed during the study period. Bone scintigraphy (30%) and diuretic renal scintigraphy (25%) were the scans performed more frequently.

Using typical yearly workload, the annual radiation dose to the hand was calculated and found to range from 6.7 mSv -10.1 mSv. It appeared to be well below the value 500 mSv/year (ICRP recommended dose limit for extremities). It is realized that the nuclear medicine unit which performed the study had followed appropriate radiation protection practices and the technologist was a well experienced worker to handle the radiopharmaceuticals.

Although doses determined in the study were well below the dose needed to result deterministic effects (skin Erythema) (0.02 Sv), there is a risk for the occurrence of stochastic effects. Therefore, it is necessary to encourage the staff to minimize the radiation dose by using appropriate protective measures whenever necessary.

DEMOGRAPHY AND AETIO-PATHOLOGY OF VALVULAR HEART DISEASES IN PATIENTS UNDERGOING VALVE REPLACEMENT

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Valvular heart disease (VHD) carries a significant morbidity and mortality. In industrialized countries, rheumatic heart disease remained the most common aetiology for VHD until recently but reducing in incidence with a rising trend of degenerative VHD with the ageing of population. However, this epidemiological shift has not been observed in developing countries and rheumatic heart disease remains the commonest aetiology.

The aim of the study was to determine the demography and pathologies found on mitral and aortic valve specimens. A retrospective study was done on mitral and aortic valve tissues sent for histological analysis from patients undergoing valve replacement from 15.01.2012 to 29.01.2014. The age and gender were noted. The specimens were studied by conventional histological techniques. Data was analyzed by using SPSS 16.

85 specimens were received during the study period. Mean age of the patients was 39.8 years. Rheumatic carditis was found in a total of 32 specimens (38%). Mitral valve involvement was 66% (n=21) whereas aortic valve involvement was 40% (n=13). 4 patients had dual valve disease. All these patients were suspected of rheumatic heart disease clinically. Other findings included myxoid degeneration (25%; mean age = 40y), calcification (22%; mean age = 54Y), fibrosis (21%; mean age = 48y) and endocarditis (2.4%; mean age=63.5y).

Of specimens confirmed of rheumatic heart disease on histology, 22 (68%) were obtained from females and 9 (28%) from males and the gender was not mentioned in one. Out of those with myxoid degeneration, 10 (48%) were females and 11 (52%) were males. 8 (42%) females and 11 (58%) males showed only calcification. 10 (56%) females and 8 (44%) males showed fibrosis only. There was 1 female and 1 male with features of infective endocarditis. The commonest valve affected was the mitral valve (56% including the dual valve involvement) and commonest aetiology was rheumatic heart disease in our study.

Rheumatic carditis still remains the main cause for valvular heart disease in Sri Lanka. However degenerative heart diseases like myxoid degeneration, calcification and fibrosis seem to be on the rise showing effects of population ageing and socioeconomic trends. Furthermore, a female predominance of rheumatic heart disease was noted in the present study, for which the causative factor needs to be looked for.

DOES DRINKING NATURAL SPRING WATER INCREASE THE RISK OF DEVELOPING URINARY STONES?

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The chemical compositions of geological materials are presumed to have an impact on the health of the inhabitants of that particular geochemical province, because of the fact that their food and water are obtained almost entirely from the terrain itself. Urolithiasis is such a disease in which the causative factors are believed to be related to the quality of drinking water.

In this descriptive hospital based study, we investigated an area with high incidences of urinary calculi for a given hydrogeochemical perspective. The patients' drinking water resource locations were mapped using a handheld GPS device and water samples were collected for analysis. Physical and chemical characteristics of groundwater water have been intensively studied in endemic areas and non-endemic areas of urolithiasis.

Analytical results showed that none of the parameters exceeded the WHO standards. However a significant difference in water hardness of prevalence areas (mean hardness: 99.3; n=54) were observed compared to the non-prevalence areas. Calcium and magnesium contents showed significant differences between the two regions but no significant difference in dissolved silica content were observed. Results concluded a significant difference between the water samples from prevalence areas and non-prevalence areas, particularly for hardness, magnesium, calcium, chloride and pH, which could have an effect on the disease in the region. A significant number of patients with urolithiasis were also identified in soft water areas according to hierarchical cluster groupings. Thus urolithiasis can be considered a multi-factorial disease, with hard water not being the only possible aetiology.

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FACTORS ASSOCIATED WITH PATIENTS' USE AND SATISFACTION WITH COMPLETE DENTURES

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One fourth of denture wearers are dissatisfied with complete dentures. Pain, looseness and difficulties during eating are common complaints. Further, a satisfactory esthetic outcome contributes largely for their acceptance of complete dentures. A general satisfaction with the complete dentures does not necessarily mean that the patients are using them all the time. Although patients' use and satisfaction with new complete dentures could be related to denture quality and patient related factors, no consensus exists among clinicians regarding causal relationships of such factors which will support a predictable patient satisfaction and use of complete dentures.

Therefore, our main objective was to investigate the influence of patient factors and denture quality on the use and satisfaction of new complete dentures in a sample of patients attending the Department of Prosthetic Dentistry, Faculty of Dental Sciences, Peradeniya.

Seventy one patients requesting complete dentures were recruited in the study with their informed consent. Those who needed immediate dentures were excluded. Socio demographic data and other relevant details were recorded. Ridge forms were classified into either of class II – VI using Cawood and Howell's method. Denture construction was done using the standardized guidelines adopted by the department to minimize the technical errors and to ensure quality of the dentures. After one week, at the 1st post insertion review, and after 1 year, at the 2nd post insertion review, the new dentures were examined using Woelfel's method. Patients were asked to complete the validated Sinhalese version of "Patient Satisfaction of Complete Dentures Questionnaire" used at Guy's hospital, UK.

Chi-square analysis revealed that socio demographic factors and other clinical factors were not related to their general satisfaction with the new set of dentures. The scores on clinical factors and technical quality showed significant positive correlations ($r=0.3$ and 0.25 respectively) with the score on *use* of dentures. But, a regression analysis revealed that patients' perception regarding dentures was not significantly predicted by patients' factors, clinical factors or technical quality of dentures. However, ANOVA revealed that the patients who expressed higher general satisfaction regarding dentures had significantly higher perception scores ($F=12.9$, $P<0.001$). Therefore, it can be concluded that the Patients' factors, clinical factors or technical quality of dentures do not predict the patients' perception regarding retention, comfort, and masticatory efficiency of dentures. Clinical factors and technical quality of dentures are associated with the use of dentures by patients. Patients who are happy with the retention, comfort, and masticatory efficiency of dentures are generally satisfied with those.

OPTIMUM CUFF INFLATION VOLUMES OF ENDOTRACHEAL TUBE FOR DIFFERENT TUBE SIZES IN SRI LANKAN ADULTS

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Over inflation and under inflation of endotracheal tube cuff can cause many complications in patients. The ideal method, which can prevent over inflation or under inflation of the cuff, is to inflate the cuff using a cuff pressure gauge, which is not available in all centers. The aim of our study was to find a correlation between the air volume needed for proper inflation of cuff and anthropometric measures. This will help to determine the volume needed for proper inflation of the cuff in patients of different body sizes, when the cuff pressure gauge is not available.

Participants were 70 males over 18 years of age, who underwent endotracheal tube insertion in the Intensive Care Unit (ICU) and operating theater of the Dental Hospital, Peradeniya. Patients with physical deformities of the chest and neck region were excluded. A normal 5 milliliter (ml) syringe was used to inject air to inflate the endotracheal tube cuff until air leaks could not be heard. The "PORTEX" brand cuff pressure gauge was used to confirm that the pressure within the cuff was within the safe range of 15-25 cmH₂O. Both the volume of air used and the cuff pressures were recorded. Size and length of the endotracheal tubes were also noted. All patients' weight, height, shoulder span and chest circumference were measured separately.

The most interesting findings of this research were that mean air volume injected for endotracheal tube size 7 was 4.63 ml and the mean cuff pressure was 20.1 cmH₂O. The mean volume injected for endotracheal tube size 7.5 was 5.5 ml and the mean cuff pressure was 20 cmH₂O. There was no correlation between the air volume injected and any of the body anthropometric measure when the total sample was considered. Also there was no significant correlation between the air volume injected and any of the body anthropometric measure when data was analyzed separately for the two different endotracheal tube sizes of 7 and 7.5.

For endotracheal tube sizes of 7 and 7.5, when air volume of 4.63 ml and 5.5 ml are injected respectively, their cuff pressures will be within the safe range. For endotracheal tubes of other sizes, a cuff pressure gauge has to be used to determine proper inflation of the cuff whenever possible.

ESTABLISHMENT AND MAINTENANCE OF LABORATORY COLONIES OF *Aedes albopictus* MOSQUITOES

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With a mission of “providing authenticated, high-quality *Aedes albopictus* mosquito rearing information to the research community” maintenance of a *Ae. albopictus* mosquito colony was started. All environmental facilities inside the insectary were carefully maintained to better suit the *Ae. albopictus* mosquito colonization. The mean temperature of 27°C (± 0.5°C) was constantly maintained inside the insectary. Wet towels on adult mosquito cage racks were used for proper maintenance of humidity. Lighting was using fluorescent light and regulated with 16:8 hour continuous dark and light period. Pest insect was controlled to ensure essential absence of ants and cockroaches. This was achieved without any harm to the mosquito colonies either directly or by contamination with toxicants transported by pests. An adult mosquito trap placed inside the insectary was used to monitor released mosquitoes. Consistent effort was also made to improve the level of cleanliness inside the insectary. Written guidelines were given to each person responsible for a task. Insectary operations included egg counting, preparation of hatching bottles with boiled distilled water following cooling to room temperature, egg hatching, larvae rearing with International Atomic Energy Agency (IAEA) recommended diet of tuna meal, bovine liver powder, brewery yeast and vitamin complex in a ratio of 37.5:27:10.5:2 g in 1L up to one week, pupae counting and putting into adult emergency cages, adult male feeding with 10% sugar solution with Vitamin complex, adult female blood feeding from 4th day onwards with bovine blood, placing egg laying cups and collecting egg laying cups, drying egg papers and starting next generation from the dried eggs. Adult mosquito cages were blood fed every 4th day after emergence from pupa and for quality control reasons each adult cage was blood fed only 3 times and there after only 10% sugar solution with vitamin syrup was supplemented until all adult mosquitoes died. Documentation for maintenance and data record was maintained and updated daily. Records included larvae feeding records, larvae tray maintenance and cleaning charts, adult feeding records with both sugar solution and blood, insectary cleaning records with time and dates. Number of eggs and percentage of egg hatching, larvae death, pupation, adult emergence, egg laying and adult mosquito death with respect of the sex and time difference were recorded. For bio-safety reasons all discarded material from larvae trays, egg laying cups and adult cages were boiled thoroughly to facilitate total destruction of the contaminated mosquito eggs. All other infectious material were incinerated. Finally, all above conditions facilitated achievement of 100% egg hatching rate within maximum of 24 hours, 100% survival of larvae to pupa (~ 7 days), 100% survival of pupated larvae to adult emergence (~ 2 days) and 95.5% adult survival up to 12 days. No difference was observed on adult longevity between males and females within first 12 days of adult emergence. However, approximate life span for males (~17 days) was lower than the females (~ 25 days) and the mortality was regular through all generations (F1 to F21).

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EVALUATION OF THE SPATIAL AND TEMPORAL TRENDS OF DENGUE OUTBREAKS IN GAMPOLA, CENTRAL PROVINCE, SRI LANKA

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Dengue is the world's fastest growing vector borne disease, and it has become one of the major health concerns in many countries including Sri Lanka. Despite immense efforts and control strategies it claims 30,000 - 35,000 deaths per year, making dengue a priority health issue in Sri Lanka. Investigation of the recent trends of dengue outbreaks on both a spatial and temporal scale is of high importance in drafting and implementing effective management/action plans to ensure successful management and control of dengue epidemics on a regional scale. Hence, a statistic and geo informatics based analysis of the recent trends in dengue distribution was carried out to identify spatial and temporal trends in distribution patterns of dengue in the Gampola Medical Officer of Health (MOH) division.

Monthly records of reported dengue cases from 2009 to 2013 of the Gampola MOH division were collected. A scatter plot analysis in MINITAB (version 14.12.0) was devised to identify the temporal patterns in the reported dengue cases. Arc GIS (version 10.1) was devised to develop spatial maps (at the GND level) of the recorded dengue case distribution for each month and for the whole study period, for Gampola. Furthermore, spatial (at GND level) and temporal (annual) variations in dengue outbreak distribution within the Gampola MOH were analyzed to recognize the recent trends in dengue distribution. Gampola East, Gampola West, Illawathura, Keerapane, Kahatapitiya, Egodakalugamuwa and Pussellawa localities emerged as high-risk areas, while Polkumbura, Kurukude, Galgediyawa, Amuhena and Hunukotugama emerged as low risk areas for dengue outbreaks. Further localities, namely Godagama, Kalugalhinna, Kekulanda, Millagaspiya, Sinhapitiya North, Sinhapitiya South, Pussellawagama, Ranawala and Wanahapuwa remained unchallenged by dengue throughout 2009 - 2013. The paired-Chi square test revealed significant spatial and temporal variations in the emergence of dengue outbreaks within the Gampola MOH throughout the study period [$>x_2(48, 0.95) = 65.156$]. Regionalized evaluation of recent trends in temporal and spatial distribution of dengue outbreaks are recommended in the design and implementation of management plans to control the rise of dengue, and also in the evaluation of the effectiveness of already implemented practices taken to reduce and control dengue outbreaks, by the government sector and other relevant entities.

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ATTITUDES AND WILLINGNESS TO UNDERGO A PAP SMEAR TEST AMONG MARRIED WOMEN IN INGIRIYA MOH AREA, SRI LANKA

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Cancer of the cervix is rated as the second cause of morbidity and mortality among cancer patients in Sri Lanka. Cervical cancer morbidity and mortality can be reduced by primary prevention and early detection strategies. The Pap smear test is a safe and effective screening test which is offered free of charge through well-woman clinics in Sri Lanka, but previous studies have demonstrated poor uptake of Pap smear test.

An interviewer-administered questionnaire was used to conduct a cross-sectional descriptive survey among 35-60 year old married women in Ingiriya MOH area. Cluster sampling was used to select participants from the gramasewa divisions of the selected MOH area. Frequency distribution with percentages was calculated using SPSS.

Mean age of the sample was 46 ± 8.4 years. Of the 456 participants only 41.3% has had a Pap smear test done at least once and most of them (22.6%) were tested at well women clinics. Public Health Midwives were their major source of information (57%). However most of the participants (73.1%) believed that cervical cancer is preventable if it is detected early through a Pap smear test. Further most of them (93.3%) were willing to participate in a screening program. Findings of the attitudinal dispositions for Pap smear test revealed that there was shyness (63%) and fear (52.7%) of vaginal examination among those who had or did not have the Pap smear test. Despite significant proportion of women believing, cervical cancer is preventable if it is detected early through the Pap smear screening test, there was an unacceptably low level of screening. Negligence, shyness and fear were the main obstacles to participate in screening.

**INFLUENCE OF NODULE OFFSET IN CAD PERFORMANCE
EVALUATION OF LUNG CANCER CT SCREENING:
A VIRTUAL NODULE STUDY**

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Detection of more than 4mm diameter nodules has been defined as positive finding by National Lung Screening Trial in North America. Computer- Aided Detection (CAD) also a very important and trusted method that can be used to detect lung cancers. There is a clinical factor called offset value which is related to nodule screening and this study was conducted to find out whether there is any influence of offset value to CAD detection.

Two main types of computer simulated virtual nodules which were in offset 0 values and offset maximum values were used in this study. Diameters of nodules were 4mm to 8mm in each offset value. Contrast differences (Δ CT) of offset 0 nodules were 100HU to 800 HU and offset maximum nodules were 100 HU to 1000 HU. Those nodules were inserted into CT images of seven different patients taken from the same institute, using similar radio graphical parameters. They were detected by using CAD system separately. True positive (TP) number of detected images was counted. Limitation of the detection ability was illustrated by graphs, using TP counters. The CAD performances were evaluated by using those graphs.

According to the mean value of those graphs, diameter 4mm to 8mm nodules in offset 0 were possible to detect with Δ CT value of 100HU to 800HU. But diameter of 4mm and 4.5mm nodules were unable to detect in offset maximum value with Δ CT value of 100HU to 1000HU. There was obvious deference between offset 0 nodule detection and offset maximum nodule detection. The study shows that there is a considerable influence of offset value on CAD detection.

COMPARISON OF TACROLIMUS 0.1% AND CLOBETASOL 0.05% IN THE MANAGEMENT OF SYMPTOMATIC ORAL LICHEN PLANUS: A RANDOMIZED DOUBLE – BLIND TRIAL IN A TERTIARY CARE CENTRE

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Lichen Planus is a common, chronic inflammatory mucocutaneous disease with unknown aetiology and putative auto-immune pathogenesis. It was first described by Erasmus Wilson in 1869. The incidence of Oral Lichen Planus (OLP) is reported to be approximately 0.5% to 2% of the world's population. OLP affects women more often than men in a ratio of 3:2.

The choice of treatment of OLP depends on the severity of discomfort, the site of lesions in oral cavity, and overall health and compliance of the patients. Recent reviews on OLP therapy suggest that high potency topical corticosteroids are the treatment of choice. Among corticosteroids, clobetasol propionate appears to be the most effective topical steroid. Further, recently there have been a few case reports and trials of successful use of tacrolimus in the treatment of OLP.

However, to the best of our knowledge, direct comparison of the efficacy between topically applied clobetasol 0.05% and tacrolimus 0.1% in the treatment of OLP was lacking. Therefore, the aim of the present study was to compare the effectiveness between topically applied tacrolimus 0.1% and clobetasol 0.05% for treatment of symptomatic OLP in a double – blind randomized clinical study. This study was carried out on 68 patients divided into two groups. Each group was prescribed with either Tacrolimus cream 0.1% or clobetasol cream 0.05% for a period of 3 weeks. The pain score and the clinical appearance was measured using Visual Analog scale (VAS) and Thongprasom classification (TC), respectively.

In the present study age of occurrence of OLP ranged from 20-77 years and the mean age of presentation was 46.7 years. A significant female prevalence (63.2%) was observed. Both Clobetasol 0.05% and Tacrolimus 0.1% were effective in the management of OLP. Further, both mean VAS and the mean score of TC of Tacrolimus group showed more improvement than the Clobetasol group.

In conclusion, tacrolimus 0.1% ointment is an effective alternative to topical steroid and may be considered as one of the first-line therapies in the management of OLP. However, other studies are needed to confirm the effectiveness of this treatment before it can be recommended for use in clinical practice.

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CHARACTERISTICS OF UROFLOWMETRY: CORRELATIONS OF AGE WITH TOTAL INTERNATIONAL PROSTATE SYMPTOM SCORE (IPSS) AND MAXIMUM FLOW RATE IN PATIENTS WITH LOWER URINARY TRACT SYMPTOMS (LUTS)

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With the gradual rise of the percentage of elderly population in Sri Lanka, assessing and treating the conditions affecting advanced age have become major concerns in health care system. LUTS is a commonly encountered problem, which affects considerably the quality of life of elderly patients. The leading recognized causes are prostate hyperplasia, prostatitis and urethral strictures. Due to these reasons, clinical management of LUTS has become an important concern in urology. IPSS and uroflowmetry are routine investigations for assessment of LUTS. Uroflowmetry is a commonly used non invasive test to measure the rate of urine flow over time. IPSS is an internationally used interview based questionnaire to assess severity of LUTS. The objectives of this study were to determine correlation between age and total IPSS and correlation between age and maximum urinary flow rate among patients with LUTS.

This was a descriptive cross sectional study carried out over one year in patients with LUTS who were referred for uroflowmetry to the Department of Surgery, Faculty of Medicine. LUTS was assessed by IPSS. Uroflowmetry was carried out according to standard method. Patient demographic details, IPSS and maximum flow rate were analyzed with descriptive statistics and Spearman's rank correlation tests.

A total of 827 patients were studied. The mean age was 62.60 years. The mean total IPSS was 17.59 (SD= 8.2) and of them 12.5%, 44.6% and 42.9% had mild, moderate and severe LUTS according to the total IPSS respectively. In mild, moderate and severe categories mean ages were 58.1 years, 61.8 years and 64.5 years respectively. Turkey Post Hoc test followed by one way anova test showed differences of mean ages were significant among mild, moderate and severe LUTS categories. There was a strong positive correlation between age and total IPSS at the 0.01 level (P value<0.0001, correlation coefficient= 0.15).

In the study group, uroflowmetry values were available for 351 patients. In the uroflowmetry study, highest maximum urinary flow rate was 46.8 ml/s with a mean maximum flow rate of 14.25 ml/s. A spearman's rank order correlation was applied to determine the relationship between patients' age and maximum flow rate. There was a strong negative correlation between age and maximum flow rate at the 0.01 level (P value<0.0001, correlation coefficient= - 0.286).

In conclusion, this study has shown that with advancing age, total IPSS increases and the maximum flow rate decreases.

EFFECT OF RECONSTRUCTION KERNEL AND SLICE THICKNESS ON THE PERFORMANCE OF CAD SOFTWARE USED IN THE SCREENING OF LUNG CANCER

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Lung cancer is one of the leading causes of cancer related deaths in many countries. Introduction of multi-detector computed tomography (CT) scanners has led to lung cancer screening studies with a large number of thinner slices, making the process of interpretation more time consuming. So a computerized method, Computer Aided Detection (CAD), for lung nodule detection to assist the radiologist is introduced. The present study was carried out at Niigata University, Japan to evaluate the performance of CAD software before being used clinically. Main objectives of the study were to investigate effect of reconstruction kernel and slice thickness for the performance of CAD software using lung cancer CT (LSCT) Screening chest phantom.

Using four-detector-row Computed Tomography scanner the chest phantom, in which simulated lung cancer nodules were placed, was scanned and images were obtained for different slice thickness (1mm, 3mm, 5mm,7mm, 10mm) and reconstruction kernels (FC 13 and FC 52). Automatic nodule detection was performed over scanned data. The false positive (FP) results and true positive (TP) results were counted and receiver operating characteristic (ROC) curves were graphed and analyzed using Microsoft Excel.

In each slice thickness FP number was less for FC 52 than FC 13. But TP ratio (TPR)s were nearly same or little less in FC 52 reconstruction kernel. At the end of the study, maximum TPR for both 5 mm (88.9%) and 7 mm slice thicknesses (100% & 88.9%) were obtained. But 5mm slice thickness resulted high FP number compared to 7mm. This chest phantom represented an averagely build Japanese individual. Low-dose CT scans that revealed any non-calcified nodule measuring at least 5 mm in any diameter and radiographic images that revealed any non-calcified nodule or mass were classified as positive, “suspicious for” lung cancer. Therefore this study aimed at the nodules with 6mm, 8mm and 10mm in diameter of the left lung. So the values that were obtained may not be applicable to non-Japanese subjects. The phantom study suggested that best performance of the software can be achieved for 7mm slice thickness and FC 13 reconstruction kernel (100%). The software must be developed to detect thinner slices and carried out in future studies.

A DESCRIPTIVE STUDY ON EPIDEMIOLOGY AND CHARACTERISTICS OF UROFLOWMETRY AMONG PATIENTS WITH LOWER URINARY TRACT SYMPTOMS (LUTS)

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Lower urinary tract symptoms (LUTS) is a common presentation encountered in urology practice. It is often due to benign prostate hyperplasia, prostatitis and urethral strictures. Evaluation and treatment of LUTS is a major consideration. The International Prostate Symptom Score (IPSS) and uroflowmetry are routine investigations for assessment of such patients. Uroflowmetry is a non invasive test to measure the rate of urine flow over time. The objectives of this study were to determine demographic data and characteristics of uroflowmetry among patients with LUTS.

This was a descriptive cross sectional study of patients with LUTS over a one-year period, conducted in the Department of Surgery, Faculty of Medicine, University of Peradeniya. LUTS was assessed by IPSS. Uroflowmetry was carried out according to standard method. Patients' demographic details, IPSS and maximum flow rate were analyzed with Spearman's rank correlation tests and descriptive statistics.

A total of 351 patients were studied, including 329 (93.7%) males and 22 (6.3%) females. Their mean age was 61.65 years. The mean total IPSS was 16.34 (SD = 12.82) and of them 15.4%, 46.7% and 37.9% had mild, moderate and severe LUTS according to the total IPSS respectively.

Their maximum urinary flow rate was 46.8 ml/s, with a mean maximum flow rate of 14.18 ml/s. Among them 37.9% patients had abnormal flow rate (<10ml/s), 43.3% had equivocal flow rate and 18.8% had normal maximum flow rate (>20ml/s). Spearman's rank-order correlation was applied to determine the relationship between maximum urinary flow rate and total IPSS among 351 patients and there was a strong negative correlation between two parameters which was statistically significant at the 0.01 level (P value<0.0001, correlation coefficient=-0.342).

The study had shown that the majority of LUTS patients are elderly males. We found that the maximum urinary flow rate decreases when the total IPSS is increasing. Therefore, uroflowmetry and IPSS can be used effectively to evaluate patients with LUTS.

CORRELATION BETWEEN PROSTATE VOLUME AND LOWER URINARY TRACT SYMPTOMS (LUTS) AS MEASURED BY INTERNATIONAL PROSTATE SYMPTOM SCORE (IPSS)

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Lower Urinary tract symptoms (LUTS) are a common presentation among elderly male patients presenting to Urologists. Evaluation and treatment of LUTS is a major consideration and International Prostate Symptom Score (IPSS) and ultrasound scan of Kidney Ureter Bladder and Prostate (KUBP) are routine investigations for assessment of such patients. The treatment is based on the presumed etiology of symptoms. (Due to obstruction, overactive bladder or a combination of both) IPSS is an interview based clinical parameter and prostate volume is measured using ultrasound KUBP. The relationship between IPSS score and the prostate volume is somewhat controversial in the western literature. The objective of this study was to evaluate the relationship between IPSS and prostate volume in the patients with LUTS.

This descriptive cross sectional study was carried out in patients referred to the urology clinic of Teaching hospital Peradeniya between June 2014 and May 2015. These patients were clinically evaluated and the IPSS of the patient was obtained by trained medical officers. Subjects less than 10 years of age were excluded. The prostate volume of each patient was estimated by abdominal ultrasound KUBP done at the Department of Radiology, Teaching hospital Peradeniya. Patient demographical details, IPSS and prostate volume results were evaluated with one way ANOVAs and Spearman's rank correlation tests.

There were 185 patients in the study population with a mean age of 65.29 years (SD=11.46). The mean total IPSS was 18.81 (SD=7.3) and the mean prostate volume was 41.6 cm³ (SD=24.2). Of them 4.4%, 50.5% and 45.1% respectively had mild, moderate and severe LUTS according to IPSS total score. The mean prostate volumes were 35.22 cm³ in mild, 38.70 cm³ in moderate and 45.93 cm³ in severe LUTS.

An increment in mean prostate sizes were noted with the severity of the IPSS, but there was no statistically significant difference between the groups as determined by one-way ANOVA ($P=0.071$). A Spearman's rank-order correlation was applied to determine the relationship between prostate volume and Total IPSS score and a strong, positive correlation between two parameters, which was statistically significant, was noted. (Correlation Coefficient=.223, $P = 0.003$)

This study has shown that there is a significant positive relationship between IPSS and prostate volume measured through abdominal ultrasound. The Total IPSS increases with the prostate volume. However there was no statistically significant difference in prostate volume among mild, moderate and severe IPSS groups.

ANALYSIS OF FACTORS INFLUENCING STRESS AMONG NURSES IN INTENSIVE CARE UNITS OF TWO SELECTED TEACHING HOSPITALS

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Intensive care units (ICUs) are challenging environments where there are medical or surgical emergencies, high technological complexity and concentration of critically ill patients having instabilities in their health conditions. Stress has been observed among health care professionals including ICU nurses. Stress is one of the main factors affecting nurses' health and quality of nursing care. In addition to their professional responsibilities, ICU nurses are required to manage their personal life to meet the family needs. Since there is a lack of evidence regarding stress among ICU nurses in Sri Lanka, the present study aimed to examine the factors that influence stress among ICU nurses from the viewpoint of nurses.

This was a descriptive study using a convenience sample of 148 nurses working in seven ICUs of Colombo South Teaching Hospital and Sri Jayawardenepura General Hospital. A pre tested self-administered questionnaire was used for data collection and the response rate was 94%. Both work related and personal stress factors were assessed using a five point frequency scale (extremely stressful, frequently stressful, occasionally stressful, never stressful, do not apply). Data were analyzed using Minitab 14 statistical software. A *p* value of 0.05 was considered as statistically significant.

According to the findings, the most "extremely stressful" factor for nurses was unavailability of adequate nursing staff (54.28%) while the other "extremely stressful" factors were, ringing telephone during busy times (50.71%), working with damaged and problematic monitors (47.17%), seeing a patient suffer (43.57%) and death of a patient (37.86%). Constant interaction with critically ill patients (32.86%) were the most "frequently stressful" factor while the other 'frequently stressful' factors were fear of making a mistake when treating a patient (30%), overlapping management methods of various consultants (30.71%), answering for relatives' calls (37.14%) and difficulty of working with a particular nurse (28.57%). Fear of making a mistake when treating a patient is not associate with having had ICU training (*p*=0.425). Although 50% were 'occasionally stressful' with feeling uncomfortable with personal life, children and household work was not significantly associated with the civil status (*p*=0.933). Factors influencing stress among ICU nurses are both work related and personal. Health authorities should pay attention on those factors and take necessary actions to reduce the impact on them. This may help to decrease the adverse effects of stress among ICU nurses and improve the quality of nursing care in ICUs.

THE ASSOCIATION BETWEEN DIABETES MELLITUS AND LOWER URINARY TRACT SYMPTOMS AMONG PATIENTS REFERRED FOR UROFLOWMETRY

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Type II diabetes mellitus and lower urinary tract symptoms are common medical conditions that affect people as they age. Diabetes mellitus is a common cause of peripheral neuropathy and it can cause both storage and voiding dysfunctions of the bladder. However the effect of diabetes on lower urinary tract symptoms (LUTS) is not fully understood. It may differ depending on various factors including the control of blood sugar level. Therefore impact of diabetes mellitus on LUTS may differ from country to country. The goal of our study was to evaluate the impact of diabetes mellitus on lower urinary tract symptoms (LUTS) among patients who were referred for uroflowmetry.

This descriptive cross sectional study was carried out from June 2014 to May 2015, including all patients referred to faculty of Medicine for uroflowmetry. LUTS was assessed by the International Prostate Symptom Score (IPSS). Co morbidities including diabetes mellitus and other information were collected using an interviewer questionnaire administered by a MBBS qualified doctor. Analysis was carried out using 20.0 version of SPSS.

A total of 379 patients aged 13-90 years were included in this analysis. Mean age of the population was 61.99 years with a standard deviation (SD) of 12.82. There were 350 (92.3%) males and 29(7.7%) females. A total of 111(29.3%) patients had diabetes mellitus. Their mean age was 64.3years (SD=9.83) and mean IPSS was 15.68 (SD=7.95). 268 patients did not have diabetes mellitus. Their mean age was 61.05years (SD=13.77) and mean IPSS was 16.59 (SD= 8.08). There was no statistically significant difference between groups as determined by Independent Samples t-Test (P=0.32). Poor stream was the commonest symptom in both groups, but mean score for any of the lower urinary tract symptoms including incomplete emptying, frequency, intermittency, urgency, hesitancy, and nocturia was not significantly different.

The results of this study suggests that there is no impact of diabetes mellitus on mean IPSS value in our study population. There is no difference in the prevalence of symptoms between diabetic and non diabetic patients. Though the literature suggested an adverse impact of diabetes mellitus on LUTS and several possible mechanisms for increase severity of LUTS in diabetic patients is described, the impact may depend on the control of blood sugar. However in this study we did not consider blood sugar values.

Another possible explanation may be that, diabetic patients may not perceive LUTS as severe as what is perceived by a non diabetic patient with the same changes in urinary system, due to the sensory neuropathy that affects them. In this study we compared only the IPSS which is totally dependent on the patients' perception. Comparing findings of this study with the flow rates and ultrasound findings of diabetic patients will give more accurate conclusions regarding the impact of diabetes mellitus on LUTS.

IMPACT OF SMOKING ON LOWER URINARY TRACT SYMPTOMS AMONG PATIENTS REFERRED TO THE FACULTY OF MEDICINE FOR UROFLOWMETRY

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Lower urinary tract symptoms (LUTS) are prevalent in the elderly population. Epidemiological evidence indicates that lifestyle and behaviors may be important in the etiology of LUTS. In particular, behaviours that may affect metabolism and inflammatory processes have been linked to prevalence of LUTS in numerous studies. Some studies have found that there is a negative impact of smoking on LUTS, but the association between LUTS and smoking is still unclear. The goal of this study was to evaluate the impact of smoking on LUTS among patients who are referred for Uroflowmetry.

The study was conducted as a descriptive cross sectional study at the Faculty of Medicine, University of Peradeniya from June 2014 to May 2015 recruiting all patients referred for Uroflowmetry. LUTS were assessed by the International Prostate Symptom Score (IPSS), smoking status and other information was collected using an interviewer questionnaire administered by a MBBS qualified doctor. Analysis was carried out using 20.0 version of SPSS.

A total of 406 patients aged 10-90 years were included in this analysis. Mean age was 61.75years (SD=13.49). There were 377(92.9%) males and 29(7.1%) females. 129 (31.68%) patients were current smokers. Their mean age was 61.83 years (SD=12.13) and mean IPSS was 17.46(SD=8.05). 191 patients had never smoked. Their mean age was 59.06 years (SD=14.93) and mean IPSS was 15.05(SD=7.99). 86 patients were ex-smokers. Their mean age was 67.25years (SD=9.67) and mean IPSS was 17.79(SD=7.88). There was a statistically significant difference between groups as determined by one-way ANOVA ($P=0.006$). Tukey post-hoc test revealed that mean IPSS was significantly higher in smokers (17.46, $P=0.023$) and ex smokers (17.79, $P=0.023$) compared to non-smokers (15.05). There were no statistically significant difference between smokers and ex-smokers ($P=0.95$). Poor stream was the commonest symptom in all three groups. The mean score for poor stream is significantly higher in ex-smokers (3.40, $P=0.009$). Even though current smokers too have higher mean score for poor stream (3.05), it is not statistically significant. Likewise mean scores for other symptoms including incomplete voiding, frequency of micturition, intermittency, urgency, hesitancy, and nocturia were higher in both smokers and ex smokers than non smokers but only some of them were statistically significant. The number of cigarettes smoked ranged from <1 pack year to 60 pack years. This study also found that there is no correlation between the number of pack years and the mean total IPSS value (Correlation Coefficient=0.298, $P=0.092$)

The results of this study suggest that there is an adverse impact of current and past smoking on LUTS in our study population. There is no significant difference between the effect of smoking and previous exposure and it is not dose related. Abstinence from smoking appears to reduce the occurrence of LUTS later in life.

ANALYZING THE FACTORS INFLUENCING THE SELECTION OF CONTRACEPTIVE METHODS AMONG MARRIED WOMEN IN SELECTED LOCATIONS OF BATTICALOA DISTRICT

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The WHO reports that the unplanned pregnancy causes 13% of the maternal deaths globally. In Sri Lanka, it has been estimated that seven illegal abortions take place for every 10 births. This indicates that the awareness among the general public about the contraceptives methods are not in satisfactory level in Sri Lanka. This has been proved that there are only 70.2% of married women use contraceptive methods in Sri Lanka (Demographic and Health Survey, 2006/2007). The social attributes play an important role in the selection of appropriate contraceptive methods. In order to make aware of the contraceptive methods among the public, the social attributes which influence on the selection of contraceptive methods should be studied. In this regard, the present study is aimed to assess the factors influencing on the selection of contraceptive methods among the married women in selected locations in Batticaloa district.

A cross sectional study was conducted in selected locations of Batticaloa district and 150 married women in reproductive age were selected using randomized sampling. The data were collected through self-administered questionnaire. The association between social attributes/factors and the type of contraceptive methods were tested using Chi square test. The results revealed that the age at marriage, women's education level, family monthly income, women's occupation, number of living child and advice from the health professional had statistically significant associations with the selection of contraceptive methods ($p < 0.05$). Religion, age of women, type of family and distance of health facility did not have statistically significant associations with the selection of contraceptive methods ($p > 0.05$).

Since the advice from the health care professionals influence on the selection of suitable contraceptive method, the health care professionals can educate general public specially the women who are vulnerable for unplanned pregnancy, through appropriate educational programmes.

ASSOCIATION BETWEEN TRUNK FLEXIBILITY, TRUNK CURVATURE AND BOWLING SPEED AMONG UNDER NINETEEN SCHOOL BOY CRICKET FAST BOWLERS IN COLOMBO DISTRICT

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The physique and body composition, including the height, weight are known to play a significant role in performance of a cricket player. The spine is an important component of the kinematic chain, transferring force from the lower to the upper limbs. According to the literature trunk flexion facilitates arm rotation, rhythm and fluidity of the bowling action and also contributes significantly to final ball release speed. The aim of this study was to assess the trunk flexibility, trunk curvature, bowling speed among under 19 cricket fast bowlers.

This study was a descriptive cross sectional study carried out with the participation of a sample of 60 fast bowlers and 60 cricket players except fast bowlers. Trunk flexibility was measured using a digital inclinometer. Trunk curvature was measured by flexicurve ruler. Bowling speed was measured by a Speed Trac X speed sports radar. Statistical analysis was done by statistical package for social sciences (SPSS) version 22.0 and statistical methods used were independent sample t-test, Pearson's correlation test.

Fast bowlers had a significantly higher bowling speed ($32.09 \pm 2.2 \text{ ms}^{-1}$) than the control group ($24.3 \pm 1.6 \text{ ms}^{-1}$; $p < 0.001$). Fast bowlers had a significantly higher height ($172.9 \pm 2.18 \text{ cm}$) than the control group ($168.8 \pm 2.4 \text{ cm}$; $p < 0.001$). There is no difference between fast bowlers and control group in regard to weight (fast bowlers $65.8 \pm 3.73 \text{ kg}$; control group $66.5 \pm 4.33 \text{ kg}$). Fast bowlers had a higher mean thoracic angle (36.87°) and lumbar angle (45.33°) compared to the control group (36.8° ; 45.02°) which was not statistically significant. Lumbar flexion, lumbar extension, thoracic flexion, thoracic extension and thoracolumbar rotation showed positive correlations with bowling speed ($p < 0.05$). No relationship was identified in bowling speed with thoracic angle and lumbar angle ($p > 0.05$).

As trunk flexibility has a significant effect on bowling speed, flexibility exercises may improve fast bowling performance. These results provide important details about the trunk flexibility and spinal curvatures of the cricket fast bowlers. This may be helpful for researchers and coaches to understand trunk injuries and their mechanisms.

A SAFETY STUDY ON A NOVEL AYURVEDIC PREPARATION, SUDARSHANA SUSPENSION, IN HEALTHY ADULT VOLUNTEERS

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Sudarshana powder (SP) is a very effective anti pyretic Ayurvedic preparation, extensively used in Sri Lanka as well as India. This contains 53 ingredients with *Andrographis paniculata* (Burm. F.) Nees as the main component (50%). The extreme bitterness of this powder reduces the patient compliance and administration to children is difficult. Therefore this powder was developed into a user-friendly standard Ayurveda suspension. The aim of this present study was to evaluate the safety of the novel formulation, Sudarshana Suspension (SS) in a group of healthy adult volunteers.

Following ethical clearance, 35 healthy volunteers of either sex were selected by open advertisement. Written consent was obtained from the participants before enrolling in to the study and the information sheet and a diary for record keeping were distributed to the participants in their own language. Sudarshana Suspension was prepared at the Pharmacy of the Institute of Indigenous Medicine, University of Colombo and the study was carried out in Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura.

Acute effects of S. Suspension were tested by measuring the alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (γ -GT), alkaline phosphatase, haemoglobin content (Hb), urea and serum creatinine to determine liver and kidney functions.

Healthy volunteers were given four doses of Sudarshana Suspension at six hourly intervals per day for 7 consecutive days. Dosage of drug was determined according to the body weight of the volunteer. A 3ml of blood sample was drawn on Day 0, Day 3 and Day 8. The liver and kidney function markers (ALT, ALP, AST, γ -GT, Creatinine and Urea) were analyzed an automated biochemical analyzer (Kone) and serum Hb was analyzed by the spectrophotometer.

There were no significant differences ($p > 0.05$) in serum levels of ALT, AST, ALP, γ -GT, urea, creatinine and Hb in Day 3 and Day 8 when compared to the Day 0 (base line) values. Healthy volunteers did not report any adverse effects, such as vomiting, headache, diarrhoea, or any other abnormal feelings during the treatment period and also the follow up period.

Therefore from the findings of this study, it can be concluded that, the novel preparation Sudarshana Suspension does not cause any significant acute effects on liver or renal functions in healthy adults.

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EPIDEMIOLOGY AND CLINICAL MANIFESTATIONS OF HUMP-NOSED PIT VIPER (GENUS: *HYPNALE*) ENVENOMATION

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Hump-nosed pit vipers of genus *Hypnale* is the commonest venomous snake bite reported in Sri Lanka responsible for 22-77% of all snake bites. There are three species of the genus *Hypnale* present in Sri Lanka namely *Hypnale hypnale*, *Hypnale zara* and *Hypnale nepa*.

A descriptive observational study involving a series of 124 patients admitted with hump-nosed pit viper bites to Provincial General Hospital, Ratnapura, Sri Lanka was conducted from May 2013 to May 2015. Identification of the species was done via the visual examination of the snake by using keys described by Maduwage et al (2009). Out of 124 snake specimens 94 (75.8%) were *Hypnale hypnale*; 22 (17.74%) were *Hypnale zara* and 8 (6.45%) were *Hypnale nepa*. Of these 29 (23.38%) were live snakes and 95 (76.61%) were dead specimens. Of The victims, 78 (62.9%) were males and 46 (37.1%) were females. The age of these patients ranged from 13-75years. The common bite sites were feet (80; 64.51%), hands (31; 25%), ankles (6; 4.83%) and forearms (3; 2.41%). Majority of bites occurred during day time (6am-6pm) and numbered 80 (64.51%) and 44 (35.48%) were bitten at night (6pm-6am). 44 (35.48%) patients were bitten while working at their home gardens, 36 (29.03%) while working in estates, 33 (26.61%) while walking on foot paths, 5 (4.03%) while walking on roads, 5 (4.03%) while sleeping indoors and 1 (0.8%) while working in a paddy field.

Local envenoming was observed in 122 (98.38%) patients which included local pain and swelling (122; 98.38%), local bleeding (35; 28.22%), bruising (10; 8.06%), blistering (12; 9.67%), necrosis at the bitten site (7; 5.64%) and local lymph node enlargement (9; 7.25%). Nine patients (7.25%) developed systemic effects which included kidney injury (7; 5.64%), coagulopathy (5; 4.03%), haematuria (1; 0.8%) and ophthalmoplegia (1; 0.8%). Of the subjects who suffered kidney injury, 4 (3.22%) developed acute kidney injury and 3 (2.4%) developed chronic kidney disease (CKD). Even though acute kidney injury following hump-nosed pit viper bites was earlier described in Sri Lanka and India, occurrence of CKD is not well documented. However 3 (2.41%) patients were diagnosed of CKD in our study of which one patient died and the others needed renal replacement therapy. All species of genus *Hypnale* cause kidney injury which is the commonest systemic manifestation.

ANALYSIS OF CLINICAL FEATURES OF A GROUP OF SRI LANKAN MULTIPLE SCLEROSIS PATIENTS

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Multiple Sclerosis (MS) is being increasingly diagnosed in Sri Lanka. Aetiology of MS is considered to depend upon the genetic and environmental factors. Since Sri Lanka is an isolated country with different geo genetic background, MS patients in Sri Lanka are hypothesized to reflect different clinical features from the typical western population of MS.

Objective of this study was to analyze the clinical presentation of Sri Lankan MS patients and compare them with the western population of MS.

Twenty one MS patients attending neurology units of Teaching Hospitals Kandy and Peradeniya from 2012 to 2015 were recruited with informed written consent. The patients had been diagnosed by consultant neurologist/ physician using the Revised Mc Donald Criteria 2010. Data regarding history, examination and MRI findings of the patients were recorded by the principle investigator. Data on clinical histories were collected by direct questioning. A comprehensive nervous system examination was performed on all patients and additional data regarding examination were collected by referring to the neurologists' documentation.

Of the 21 patients, 71.5% were females with a female to male ratio of 2.5:1. Average age was 35.6 years. Average EDSS was 4.0. Seventy six percent were RRMS with 19% and 5% of secondary progressive type and clinically isolated syndrome respectively. Sensory symptoms were observed in 66.7% and motor disability in 61.9%. Optic neuritis was seen in 57%. Cerebellar symptoms, sphincter involvement and neuropsychiatric related symptoms were seen in 38%, 14% and 19% respectively.

MS is a disease common among females. This study has confirmed the same distribution by the observation of 2.5:1 female to male ratio. When compared to the typical MS prevalent western populations our study group shows a late average age of onset (35 years). Average EDSS (Kurtzke Expanded Disability Scale) of the patients in the study group is 4.0, indicating that most of the patients are currently in a relatively mobile, self sufficient stage of disease. Of the subtypes of MS, relapsing remitting type was observed to be the common type of MS. However the percentage is much lower than that of the western population. Sensory symptoms are reported to be the commonest presentation in western countries and our population was no different. Optic neuritis is described as the second commonest presentation among Asian MS patients. We too observed a large proportion of our patients had presented with optic neuritis thus confirming the above.

Multiple Sclerosis in Sri Lanka is a disease common in females and its first presentation occurs in mid thirties. The most common presenting symptoms are related to sensory and motor systems and in addition, large number presented with optic neuritis. We conclude that MS patients in Sri Lanka share most of the clinical features of western MS patients.

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MAGNETIC RESONANCE IMAGING CHARACTERISTICS IN A GROUP OF MULTIPLE SCLEROSIS PATIENTS IN SRI LANKA

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Diagnosis of Multiple Sclerosis (MS) depends largely upon clinical and Magnetic Resonance Imaging (MRI) features according to Revised McDonald criteria 2010. However utility of these criteria in Asian countries is challenged in recent literature as they have been developed based only on Caucasian population. There is a paucity of studies in Sri Lankan population to verify the compatibility of these criteria in our population.

Objective of the study was to determine the compatibility of features of MRI lesions in a group of Sri Lankan MS patients with revised McDonald 2010 MRI criteria for diagnosis of MS.

Fifteen clinically diagnosed MS patients with MRI reports were recruited for the study from Teaching Hospitals Kandy and Peradeniya during 2012 to 2015. Their MRI reports were studied and the locations of hyperintense T2W central nervous system lesions were recorded and categorized into periventricular, juxtacortical, infratentorial and spinal cord regions according to Revised McDonald MRI criteria 2010. In addition available reports of follow up MRIs and Gadolinium enhanced MRIs were studied to determine the compatibility of the features of CNS lesions with revised McDonald 2010 MRI criteria for diagnosis of MS.

In the selected study group 73.3% were relapsing remitting MS (RRMS) patients and 26.7% were secondary progressive MS (SPMS) patients. 8 patients had follow up MRI scan reports and Gadolinium enhanced scans. Seven patients had only a baseline scan. Analysis of locations of central nervous system lesions revealed 93%, 71%, 36% and 28.5% had lesions in the periventricular, infratentorial, spinal cord and juxtacortical areas respectively. In the analysis of compatibility of dissemination in space (DIS) and dissemination in time (DIT) criteria of McDonald 2010 with the features of MRI lesions in our patients, it was revealed that 62.5% of patients fulfill both DIS and DIT criteria. However, 37.5% fulfilled DIS criteria, but not DIT criteria.

Majority of the CNS lesions were located in the typical locations for MS lesions mentioned in Revised McDonald 2010 criteria. However all the clinically definite RRMS and SPMS patients who fulfilled Dissemination in Space (DIS) criteria did not fulfill the dissemination in time (DIT) criteria. The genetic and environmental heterogeneity of our population may have played a role in this contradiction. However a larger study group is required to confirm this finding.

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PREVALENCE AND ASSOCIATED FACTORS OF FLAT FOOT AMONG 6 -10 AGED SCHOOL CHILDREN IN GANGAIHALA KORALE EDUCATIONAL DIVISION

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Flat foot is a condition in which the medial longitudinal arch is depressed or collapsed. Previous studies have found that many factors are associated with flat foot. Furthermore prevalence of flat foot is highly variable in different world populations. Although flat foot is common among children and its incidence decreases with age, prevalence of flat foot among Sri Lankan children and its distribution among different age groups has not been previously studied. Our main objective was to investigate the prevalence and associated factors of flat foot in 6-10 aged children. Our specific objectives were to determine the association between prevalence of flat foot with age, gender and BMI.

Normalize navicular height of 722, 6 to 10 year old school children were assessed using two clinical measurements (navicular height, truncated foot length). Weight and height of the subjects were measured to calculate body mass index. Age and gender of the children were also recorded. Calculated normalize navicular heights were plotted in a distribution curve. Area under the curve between +1SD and -1SD was considered as normal foot. Area under the curve which is left to the -1SD was considered as flat foot.

Overall prevalence of flat foot among 6-10 aged school children in Gangaihalakorale educational division was 16.06%. The prevalence of flat foot in 6,7,8,9 and 10 aged children were 26.35%, 16.19%, 12.75%, 13.57% and 11.1%, respectively. Prevalence of flat foot was high in overweight children (21.05%). Prevalence of flat foot among males and females were 47% and 53%, respectively.

This study suggests that there is a significant association between flat foot and age ($p < 0.05$). Prevalence of flat foot decreases with advancing age. Furthermore, there is a significant association between flat foot and BMI ($p < 0.05$). Prevalence of flat foot is higher in overweight children than normal weight and underweight children. There is no significant difference of flat foot observed between males and females.

AN AUDIT ON THE OCCUPATIONAL DISTRIBUTION OF PATIENTS WITH UROLITHIASIS PRESENTING TO TEACHING HOSPITAL PERADENIYA (THP)

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Ureteric colic is a frequent presentation among surgical admissions in THP. It is commonly caused by urinary tract calculi. A low urinary volume due to less fluid intake and increased insensible water losses are an important risk factor for urinary stone formation. Occupation is a major determinant factor of daily water intake, perspiration and frequency of bladder emptying. The present study focused on assessing the pattern of occupational distribution of patients diagnosed with urolithiasis.

This study was conducted as descriptive cross sectional study using data from patients admitted to surgical wards THP from May 2014 to May 2015. The study enrolled 191 patients whose ureteric colics were confirmed both clinically and radiologically. Typical symptoms were evaluated to assess the patients clinically while X-ray Kidney Ureter Bladder (KUB) and Ultrasound KUB scan were performed. Demographic details including occupation, ureteric stone site and size were recorded.

There were 150 males (78%) and 41 females (21%) respectively. Their mean age was 44 years. Data analysis results revealed that 80.06% were outdoor workers whereas only 19.94% were indoor employees in our study. In the study population 0.08% were senior officials and managers, 1.5% professionals, 1.3% technicians and associated professions, 2.09% clerks, 24% sales and service workers and proprietors (including army officers 16.2%), 10.4% skilled agricultural and fishery workers, 18.76% craft and related workers, 23% plant and machine operators and assemblers and 18.3% elementary workers. In the Sri Lankan central bank annual report in 2014 shows the normal distribution of population and labor force as follows; senior officials and managers 4.7%, professionals 6.3%, technicians and associate profession 5.9%, clerks 3.7%, sales and service workers and proprietors 11.1%, skilled agricultural and fishery 19.3%, craft and related workers 17.1%, plant and machine operators and assemblers 8.4%, elementary occupation 22.8% and not identified 0.6%. The annual report on census of housing and population 2001 mentioned 4.7% were armed forces and related workers.

In conclusion, comparing to the general population, the population of patients diagnosed with urolithiasis consisted of higher percentages of outdoor workers, mainly armed forces, elementary workers, plant and machine operators and assemblers which included drivers. According to their work pattern these workers usually have increased respiratory and cutaneous water loss due to hard physical workouts and low intake of fluids, suggesting these factors as important risk factors for urolithiasis. Thus, mainly outdoor workers have an occupational risk of urolithiasis, giving room for preventive interventions. In addition this study showed that men are at a higher risk of forming urinary tract stones than women.

Not Presented

IN VIVO CONTACT ANALYSIS OF METACARPOPHALANGEAL (MCP) JOINT USING MAGNETIC RESONANCE IMAGING (MRI)

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Metacarpophalangeal (MCP) joint injuries are more common traumatic injuries. It is important to understand the biomechanics of the fingers muscle architecture and structure for assessment of contact analysis and helps to investigate pathological condition and progression of treatment. MCP joint is a diarthroidial joints between the heads of the metacarpal bones and the bases of the proximal phalanges. MCP Joint stability is provided by the articular surfaces, capsuloligamentous structures and musculotendinous units. The MCP joint permits flexion-extension and abduction-adduction as well as axial rotation of the proximal phalanx on the metacarpal bone.

Aims of this study are to assess the biomechanical function of the MCP joint *in vivo* and to evaluate the characteristics of the contact state of the joint with the motion of the bones in the MCP articulation.

Four healthy male subjects were scanned on extremity Magnetic Resonance Imaging (MRI) scanner (GE Healthcare Optima MR4306 1.5T). MCP joints at different posture, neutral position (0°), 45° flexion, 90° flexion and hyper-extension (-45°) were obtained using a T1 weighted 3D Gradient Echo with fatsaturation pulse sequence. The contact area between proximal phalangeal base (PPB) and MCP was measured and recorded using the imageJ software and coefficient contact distribution of the MCP joint was determined using Zed View software for three-dimensional modeling.

The evaluated averaged contact area of the entire cartilage of metacarpal head (MCH) is 22.1±3.8 (mm²), 23.4 ±2.3 (mm²), 24.9± 4.1(mm²), 26.2 ±4.3 (mm²) and proximal phalanx base (PPB) is 45.0 ± 7.4 (mm²), 47.4 ±3.0 (mm²), 50.4± 5.6 (mm²), 53.0 ±5.4 (mm²) for flexion angle of -45°, 0° (neutral), 45° and 90° flexion respectively.

The smallest contact area was found at hyperextension position but highest at 90° flexion. The contact areas were gradually increasing from -45° to 90° the flexion angle of the MCP joint due to extension movement.

DETERMINATION OF SUN PROTECTION FACTOR OF COMMERCIALY AVAILABLE SUNSCREENS

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Skin cancers are within the first fifty causes of deaths according to the health profile of Sri Lanka. Over exposure to ultra violet (UV) solar radiation during noon time is recognized as a cause of negative effects on human skin and is known to cause skin cancers. A majority of Sri Lankans do not get skin cancers due to UV exposure because of their dark skin, but get photo dermatitis and premature aging due to excessive sun exposure. UV exposure for a long time can also cause skin cancers in adolescents and children. Therefore it is important to use sunscreens with the correct Sun Protection Factor (SPF) to protect skin from UV exposure. This preliminary study was designed to determine SPF of commercially available sunscreens in Kandy.

Ten different commercially available sunscreens produced by various manufactures were purchased from Kandy. The labeled SPF values ranged from 15 to 30. The sunscreens were labeled from product A to J. In vitro SPF was determined according to the spectrophotometric method of Dutra *et al* by diluting with ethanol.

Results from product B and product F were closely in agreement with the labeled SPF values. Observed values of other products deviated highly from the labeled SPF values. The product C exhibited a maximum absorbance among all the samples analyzed in this study. This may be due to the presence of more sunscreen active ingredients in product C compared to other samples. The observed SPF values of products A, B, C, D, F, G and H were greater than two. 20% of commercially available sunscreens had closer SPF values with the labeled values and 70% of observed SPF values were greater than two. According to the literature a SPF value for sunscreens above two is considered good sunscreen activity and they can prevent sunburn, but not skin cancers or early skin aging. But a SPF value more than 15 is considered as a good sunscreen. Many reasons other than the properties of the active ingredients, can affect the results of the observed SPF value. The storage conditions, emulsion type use in the sunscreen, effects and interaction of the vehicle component, emulsion rheological properties, pH of the compounds, and the different solvents used in the preparation of sunscreens can all decrease or increase UV absorbance.

This preliminary study reveals that the mentioned protection in the label of commercially available sunscreens was not demonstrated in most of the sunscreens, even though they had sunscreen effect. Therefore this matter should be considered when strengthening the regulations of sunscreens, since they are registered as cosmetic products in Sri Lanka.

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PREVALENCE OF HYPERTENSION AND ASSESSMENT OF ITS MANAGEMENT IN RELATION TO THE LIFE STYLE MODIFICATIONS IN A RURAL COMMUNITY IN THE DISTRICT OF KANDY

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Hypertension is a major risk factor for cardiovascular diseases and is responsible for 7.5 million deaths, which accounts for 12.8% of all deaths globally. Despite the availability of a free health care system in Sri Lanka, no organized routine programs are available to screen the population for hypertension. Lifestyle modifications include dietary modifications, regular exercise, cessation of smoking and weight reduction. This study was planned to explore the prevalence of hypertension at the Yatinuwara divisional secretarial area, and to assess the current patient management system in relation to lifestyle modification among known hypertensives.

This descriptive study consisted of 321 participants. Data was collected using a pretested standard questionnaire. Blood pressure was measured under standard protocol. The International physical activity questionnaire was used to assess the level of physical activity in terms of Metabolic Equivalence of Time, (MET). Statistical software was used to analyze data.

Elevated blood pressure values were found in 175 (54.5%) subjects. Of them 114 (65.1%) were previously diagnosed patients and 61 (34.9%) were new cases. Among the previously diagnosed patients, only 99 (86.8%) subjects were on antihypertensive drugs. Despite the fact that they were on treatment, blood pressure in 90 (89.1%) patients was not under control. There were 30 diabetic patients among the known hypertensives. Among 15 known hypertensives who were not on any drugs, 7 (47%) and 10 (66.7%) had high values for systolic and diastolic blood pressures respectively. Within the known hypertensive group, there were 43 smokers and 21 (48.8%) of them were given advice to cease smoking. Six (28.6%) of them had continued to smoke. Special dietary modifications were recommended to 51 (44.7%) patients and 30 (26.3%) were advised on weight reduction. The importance of daily physical exercise was explained to 30 (26.3%) patients. There were 14 current alcohol users out of 54 previous alcohol users within the 114 hypertensive patients. The mean of the metabolic equivalence of time (MET) of the non-hypertensive subjects was higher than the hypertensive subjects and the difference was found to be statistically significant ($p < 0.001$).

The findings of this study clearly indicate a high prevalence of hypertension within the study area, and poor utilization of lifestyle modifications in management of hypertension, which could be a reason for poor hypertension control status seen in this study population.

CHANGES IN SERUM NITRITE AND NITRATE LEVELS IN DENGUE AND DENGUE HEMORRHAGIC FEVER

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Nitric oxide (NO) is produced through a cascade of mechanisms of innate immune response and is one of the major contributing factors in the pathogenesis of severe dengue infection. It is an unstable molecule that quickly converts to more stable forms such as nitrite (NO₂⁻) and nitrate (NO₃⁻), which are collectively known as NOx. This study examines the prognostic value of serum NO₂⁻, NO₃⁻ and NOx with respect to disease severity and days of fever.

Clinically confirmed dengue fever (DF, n=60) and dengue haemorrhagic fever (DHF, n=48) patients were selected from the Colombo North Teaching Hospital (CNTH), Ragama. Blood samples (~8 hours fasting) were collected at different stages of disease; admission (A), critical (C) and discharge (D). Disease was confirmed by detection of NS1 antigen using rapid diagnostic kit and IgM levels were measured using an ELISA kit. Griess and Modified Griess assays were carried out using deproteinized sera to detect the NO₂⁻ and NOx levels respectively. Serum NO₃⁻ was calculated by subtracting NO₂⁻ from NOx.

The results of the analysis of serum NO₂⁻ levels showed significantly higher values in DHF-A (Mean ± SD, 1.53±0.70 μM) patients compared to that of DF-A (1.24±0.47 μM, p=0.027, independent sample t test). However, NOx and NO₃⁻ in DHF-A was significantly low compared with that of DF-A (p=0.001 and p<0.001 respectively). In addition, a similar trend of lower serum NO₃⁻ was observed between DF-D (3.65±1.00 μM) and DHF-D (3.09±0.79 μM, p=0.018). The ROC curve analysis for serum NO₂⁻ between DF-A and DHF-A showed 62.6% area under the curve (p=0.036). The cut off value for serum nitrite in DHF-A was determined as 1.255 μM with a sensitivity of 63.9% and a specificity of 60.5% at the 95% confidence interval. Analysis of serum NO₂⁻ and days of fever on admission revealed significantly higher NO₂⁻ levels on the 6th day of fever in DHF-A compared to DFA (p=0.026). Moreover, DHF-A recorded significantly lower NO₃⁻ on the 3rd day of fever compared to DF-A (p=0.002). Considering NOx, in DHF patients who were admitted on the 3rd and 4th day of fever had recorded significantly lower NOx levels compared to DF-A. The association between serum NO₂⁻ and NOx revealed significantly positive correlation in DHF-A (r = 0.637, p<0.005) and DHF-D (r= 0.522, p= 0.022). Serum NO₂⁻ is produced exclusively from nitric oxide if there is no involvement of dietary and other external factors. Therefore, significantly high NO₂⁻ levels in DHFA on 6th day of fever is a better prognostic indicator for severe dengue whereas significantly low levels of NO₃⁻ and NOx are found in DHFA on 3rd and 4th Day of fever. Higher NO₂⁻ levels in DHFA may be due to high production of nitric oxide triggered with the progression to disease severity.

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USE OF OVITRAP SURVEILLANCE IN ASSESSING DENGUE OUTBREAK RISK IN SELECTED AREAS IN COLOMBO DISTRICT

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Dengue is one of the most important public health concerns in the world which has become a leading cause of hospitalization and death among children in several countries including Sri Lanka. At present, vector control targeted at the two main dengue vectors *Aedes aegypti* and *Aedes albopictus*, remains the only effective method in preventing dengue transmission. Accordingly, vector surveillance studies play an important role in controlling disease outbreaks. As such, current study was aimed to assess the *Aedes* mosquito abundance and the risk of disease outbreak using ovitrap surveillance in four selected areas in Colombo, where the highest dengue prevalence was recorded during the first quarter of the year. A total of 554 ovitraps were placed during the first three months of the year 2015 in Kirulapone (N=104), Dematagoda (N=116), Grandpass (N=216) and Thummulla (N=118) areas. The mosquito larvae were identified using standard taxonomic keys. Ovitrap surveillance measures i.e. Ovitrap Index (OI) and Monthly Ovitrap Index (MOI) were calculated for both *Aedes aegypti* and *Aedes albopictus*. *Ae. aegypti* showed a tendency to have higher OI values than *Ae. albopictus* for Kirulapone, Grand Pass and Thummulla areas with a significant increase at Kirulapone area ($P<0.05$). However, this tendency was reversed in Dematagoda. Nevertheless, when all four study areas were taken together, there was a significant increase in OI for *Ae. aegypti* (61%) compared to that of *Ae. albopictus* (53%) for both indoor and outdoor ovitraps. Although these two species share the same breeding places, this study indicates that *Ae. aegypti* is dominant over *Ae. albopictus* in both indoor and outdoor habitats. Furthermore, *Ae. aegypti* showed a tendency to have higher MOI values than *Ae. albopictus* during the entire study period with a significant increase in March ($P<0.005$). Furthermore, the MOI of *Ae. aegypti* decreased during the first three months with a marked reduction (from 27.40 to 20.40%) in March. This decrease was inversely proportionate to the average rainfall measurements of the first three months (1.05, 4.36 and 7.13mm). *Ae. albopictus* also showed approximately similar MOI values for January and February with a rapid decrease in March (from 25.60 to 10.70%). In addition, mean number of larvae per ovitrap was high for *Ae. aegypti* than that of *Ae. albopictus*. The values ranged from 3.25 to 4.97% and from 2.8 to 3.7%, respectively for the two species. This indicates that *Ae. aegypti* was more abundantly found at breeding sites than *Ae. albopictus* within the study areas. Although *Ae. aegypti* is regarded as an endophilic species that lives and breeds mostly indoor, our ovitrap indices suggest that it has replaced *Ae. albopictus* at outdoor breeding sites. The fact that the observed OI values were greater than 10% indicated that the areas investigated are at risk of possible dengue outbreak requiring prompt vector control methods. The decreasing MOI values with increasing rainfall may reflect the preference of *Aedes* mosquitoes to breed at natural sites when available, highlighting the importance of continuous destruction of breeding sites in the environment. The high mean larval number per ovitrap for *Ae. aegypti* reiterates the stability of its population which again emphasizes its role as a major epidemic vector calling for immediate vector control measures.

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PREVALENCE OF DIABETES MELLITUS IN A SELECTED RURAL COMMUNITY IN KANDY DISTRICT AND THE ASSESSMENT OF UTILIZATION OF LIFESTYLE MODIFICATIONS

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Diabetes mellitus (DM) is considered to be a main cause for the global burden of diseases. DM was responsible for 1.5 million deaths in 2012 and 89 million Disability Adjusted Life Year (DALY)s in 2014. The present study was conducted to assess the prevalence of DM in a selected rural community in the Kandy district and to assess the utilization of life style modification by the diabetic patients.

This descriptive study was conducted on a random sample of 321 previously diagnosed type 11 diabetes patients who were above 40 years of age. A pre-tested standard questionnaire was used to gather information on socio-demographic characteristics, details of anti-diabetic drug use and life style modifications of the participants. In addition, anthropometric measurements were collected to calculate the Body Mass Index (BMI) and waist to hip ratio.

There were 57 (17.8%) diabetic patients among 321 subjects. Of them 17 (29.8%) were males and 40 (70.2%) were females. Forty-two (73.7%) patients were on oral anti-diabetic drugs and 2 (3.5%) were on insulin treatment. Three patients (5.3%) were on traditional drugs. Out of the 57 patients, 46 (80%) were given dietary advice regarding diabetic diet and 26 (46%) were advised on weight reduction. Out of 15 smokers among the diabetics, 6 (40%) were advised to cease smoking. Of them 5 (33.3%) continued to smoke despite the advice. There were 16 (28%) alcohol consumers at the time of diagnosis. Of them 7 (43%) continued to consume alcohol. The mean BMI of the diabetic and non-diabetic patients were 25.1 kg/m² and 23.0 kg/m² respectively. This difference was statistically significant (p=0.01). However the difference of waist hip ratio between the two categories was not statistically significant.

Prevalence of diabetes in the above 40-year population was 17.5 %. This study also shows that there is poor utilization of lifestyle modification as a treatment regime.

THE EFFECTS OF COMMONLY USED FUNGICIDE “MANCOZEB” ON EMBRYO IMPLANTATION AND FERTILITY *IN VIVO* MICE STUDY

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The fungicide Mancozeb is one of the newly described endocrine disruptors, which is commonly used in the control of the fungal diseases of plants. Many studies have shown that the exposure of Mancozeb causes several harmful effects on humans and animals. Its interference on the hormonal function causes various negative effects on the reproductive system. The present study was undertaken to evaluate the effect of Mancozeb on embryo implantation using mice as an *in vivo* model. Female 14 weeks old ICR mice were administered Mancozeb orally at 0, 1, 16 or 32 mg/kg body weight from gestation day (GD) 1 to GD 8 after the confirmation of mating. At the GD 8 mice were sacrificed and the number of embryonic implantation sites was counted. The uterus, ovary and oviduct were dissected out and fixed. Haematoxylin & Eosin stained micrographs were prepared and analyzed for structural abnormalities. A generation study was conducted with the mice that were administered orally at 0, 0.3, 3 or 30 mg/kg of Mancozeb from GD 1 to GD 4 after the confirmation of mating. Length of the gestation period and litter size were observed. At the 12th week, randomly selected F₁ female mice (n=3) were sacrificed and weights of reproductive tracts and ovaries, and uterine gene expressions were measured. Again F₁ female mice were mated with mature adult males and held until delivery. Length of gestation period (F₁) and litter size were observed. In a separate study, mice were exposed to similar doses of Mancozeb as in the generation study, throughout the full length of estrus cycle. Body weight increments, lengths of reproductive tracts and weights of ovaries were measured. Number of embryonic implantation sites were significantly lower (Mann Whitney U test, p<0.05) in mice administered with 32 mg/kg BW/day (T3) compared to the control. Structural abnormalities in tissues were observed in Mancozeb treated group compared to control. In the generation study, Mancozeb did not produce any apparent carry over effects in F₁ or F₂ mice, and produced no significant changes in gestation period, litter size and female reproductive organ weights. The expression level of p53 mRNA was up regulated compared to control in F₁ females. Body weight increment and length of reproductive tract were significantly lower in mice treated with 30 mg/kg BW/day compared to control (Mann Whitney U test, p<0.05). Overall, the present data suggest that exposure to high dose of Mancozeb may impair mice embryo implantation and reproductive tract structural disorders leading to infertility.

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CORRELATION BETWEEN ANAEMIA AND THIOBARBITURIC ACID REACTIVE SUBSTANCES IN PATIENTS WITH LONG TERM DIABETES MELLITUS

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Anaemia is a frequent condition in patients with diabetes, but most of them are rarely tested for haemoglobin (Hb) and are unaware of the link between anaemia and diabetes. Correcting anaemia is considered as important part of slowing or even halting the progression of diabetic complications. Oxidative stress is known to be a positive contributor for anaemia, apart from its effects on lipid peroxidation and DNA damage. Serum concentrations of thiobarbituric acid reactive substances (TBARS) are an index of lipid peroxidation and oxidative stress. The correlation between anaemia and oxidative stress in diabetes mellitus patients in the Sri Lankan population, however, is unknown. Hence, a study was conducted on Hb concentration and TBARS concentration in patients with long term diabetes mellitus.

The study group comprised of 26 males and 24 females having diabetes mellitus for more than five years and between 20 - 65 years of age and 30 controls (19 males and 11 females). Hb concentration was measured by cyanomethaemoglobin method. The presence of anaemia was defined by Hb < 13 g/dL in men and < 12 g/dL in women. TBARS concentration was measured using thiobarbituric acid reagent.

There was a significant negative correlation ($r = -0.445$, $P < 0.01$) between Hb concentration and TBARS concentration in the patient group. The mean Hb concentration was 12.1 ± 1.4 g/dL in the diabetic group and 14.4 ± 1.5 g/dL in controls and the difference between the groups was strongly significant ($P < 0.001$). A total of 29 patients (58%) had anaemia. The mean TBARS concentration of 2.22 ± 1.58 $\mu\text{mol/L}$ was significantly ($P < 0.001$) higher in total patients than in controls (1.21 ± 0.60 $\mu\text{mol/L}$). Prevalence of anaemia in male patients was 26% and 32% in female patients. TBARS concentration was significantly higher in anaemic male patients (3.13 ± 2.36 $\mu\text{mol/L}$, $P = 0.01$) and non-anaemic male patients (1.72 ± 0.51 $\mu\text{mol/L}$, $P = 0.013$) than the control males (1.2 ± 0.5 $\mu\text{mol/L}$). TBARS concentration was also significantly ($P = 0.05$) higher in the anaemic male patients than the non-anaemic male patients. The mean TBARS concentration in the control females, non-anaemic female patients and anaemic female patients was 1.2 ± 0.8 $\mu\text{mol/L}$, 1.36 ± 0.81 $\mu\text{mol/L}$ and 2.32 ± 1.36 $\mu\text{mol/L}$, respectively. TBARS concentration was significantly lower in control females ($P = 0.012$) and non-anaemic female patients ($P = 0.042$) than the anaemic female patients. No significant difference was noted in TBARS concentration between males and females. The study revealed evidence of significantly increased oxidative stress in long term diabetes mellitus patients with anaemia.

EVALUATION OF THE RADIATION DOSE DURING THE MULTIPHASE ABDOMINOPELVIC SCAN OF MULTIDETECTOR COMPUTED TOMOGRAPHY (MDCT) IN DIFFERENT TYPES PROTOCOLS

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Computed tomography (CT) is useful for diagnostic purposes of abdominopelvic diseases and is one of the most important radiological examinations undertaken worldwide. It's usage has increased dramatically over the years. CT delivers much higher radiation dose than conventional radiography. It is important to limit the area exposed and focus only on the area of concern in order to limit the radiation dose to the patient. There is little information on amount of radiation received from multiphase CT scan of abdominopelvic region when applied in clinical practice, as most published studies focused on phantom studies. We sought to estimate the radiation dose associated with the multiphase abdominopelvic scan of CT studies in clinical practice.

In this retrospective cross sectional study describing radiation dose associated with diagnostic multiphase abdominopelvic scan of studies with sixteen slice CT performed on 90 patients at two different hospitals with two types of multi detector computed tomography (MDCT) between January 5th and May 28th, 2015, following key points were highlighted.

Data analysed revealed that overall CTDI_(volume) median was 34.9 mGy for multiphase abdominal scan with scanner A while it was 59.66 mGy for scanner B. Effective dose for multiphase abdominal CT scan range from 8.24 mSv to 57.39 mSv. Median effective dose of scanners were 21.37 mSv and 36.84 mSv respectively. The median effective dose between non contrast abdominopelvic scan of both scanners and multiphase abdominopelvic scan of both CT scanners, a significant difference ($P<0.05$) was observed. Effective dose of patients received from both CT scanners for multiphase abdominopelvic scans were higher and deviate significantly from reference level of phantom studies. Radiation dose differ significantly between the type of CT scanner and imaging techniques of abdominopelvic scan. Inherent properties and new imaging technologies among venders mostly influence the deviation of effective dose between them.

OPTIMIZATION OF THE CELL CULTURE MEDIA TO OBTAIN THE MOST EFFECTIVE NUTRIENT CONCENTRATIONS IN THE MEDIUM FOR THE GROWTH AND MAINTENANCE OF THE MYELOMA CELLS

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Cell culture can be described as the removal of cells, tissues or organs from an animal or a plant and their subsequent placement into an artificial environment. Basically, proper temperature, substrate for cell attachment, appropriate growth medium and correct pH and osmolality in the medium should be properly maintained in order to achieve a better growth in the cells. Typically, a culture medium is composed of a complement of amino acids, vitamins, inorganic salts, glucose, and serum as a source of growth factors, hormones, and attachment factors. The objective of this study is to optimize culture media in order to obtain the most effective nutrient concentrations in the medium for the growth/maintenance of NS0 Myeloma cell

Myeloma cells for the monoclonal antibody production were prepared using Dulbecco's Modified Eagle Medium (DMEM) as the growth media for the NS0 cell culture. In this study, the culture media was optimized in order to obtain the most effective concentrations in the media. Primarily, in order to culture the cells soon after thawing, 10% growth media was used and then the grown cells were transferred in to a nutrition rich media- Hypoxanthine Thymidine (HT) medium.

The growth of the Primary cell culture, soon after thawing, was observed within 2 days of culturing. A 60% of the bottom of the culture flask was covered with the healthy NS0 myeloma cells. The transferred cells were also grown to a rate of 60% within 2 days of transferring. The 10% growth media comprises with 422 mL of DMEM with added 4500 mg/L glucose without L-glutamine and sodium pyruvate, 50 mL of Fetal Clone Serum, 12.5 mL of 1M HEPES buffer (4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid), 5 mL of 200 mM Glutamin, 5 mL of 100X Non-essential amino acids, 5 mL of 100 mM Sodium pyruvate and 0.5 mL of 55mM β -mercaptoethanol. The HT medium comprises with 366.5 422 mL of DMEM with added 4500 mg/L glucose without L- glutamine and sodium pyruvate, 100 of mL FetalClone serum, 12.5 mL of 1M HEPES buffer, 5 mL 100X HT supplement, 5 mL of 200 mM Glutamin, 5 mL of 100X Non-essential amino acids, 5 mL of 100 mM Sodium pyruvate, 0.5 mL of 50 mg/mL Genatamicin, 0.5 mL of 55 mM β -mercaptoethanol and 25 μ L of Interlukin-6

Since both the culture media showed optimum growth of the Myeloma cells, the above protocol with the provided concentrations of the nutrients could be used to maintain/ grow NS0 myeloma cell line in the laboratory.

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DISPENSING PATTERNS OF CONTROLLED RELEASE TABLETS IN KANDY MUNICIPAL AREA, SRI LANKA

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Controlled release (CR) tablets are designed to deliver the therapeutic agents at predefined rates over an extended period of time. Sometimes they are being prescribed and/or dispensed in a way that they should be split into two parts to get half strength, especially when the tablets with required strength are not available. As a result of damaging the design, unintended levels of drug can be released into the blood. Pharmacists have an immense responsibility in ensuring the patients get medicines in proper manner. Therefore this study was carried out with the objective of identification of dispensing patterns of CR tablets.

Fifteen individuals of pharmacy staff were interviewed using a mini-structured, researcher- administered questionnaire after obtaining the verbal consent. Only the individuals who dispense medicines and have been employed more than 2 years in pharmacies in Kandy municipal area were included in the study. The individuals who do not dispense medicines and the individuals who have been employed less than 2 years in pharmacies were excluded. Only one person was interviewed from one pharmacy to avoid interventions by each other to their answers when they were from the same pharmacy and to protect randomization of the sample.

Experience in dispensing of interviewed pharmacy staff ranged from 2-51 years. Only 3 of them have qualified as pharmacists and 4 were following a pharmacy course. Others have only the working experience. Majority (73%) were aware that CR tablets release the drug slowly and frequent dosing is not necessary. All of them replied that splitting of a CR tablet will give undesirable effects. Seven of them said that the CR tablet will not give intended results if it's crushed. However, only two people were aware about the technology used to prepare the CR tablets and why they shouldn't be broken. When they were asked about their reaction when they get a prescription according to which CR tablets should be broken, all of them said that they are checking for the score mark on the tablet. Ten of them said that they will direct the patient again to the prescriber if the score mark is not on the prescribed CR tablet. Other replies include dispensing according to prescribers instructions, substitute the brand with similar CR brand or generic of the prescribed strength, refuse dispensing, inform patient and act according to his/her response.

CR tablets are not meant to split. Pharmacists can refuse dispensing if they feel that what they are doing may harm the patient. However, only 3 of them were pharmacists. According to this study, pharmacy staff conveys the message to the prescriber through the patient. This doesn't allow detailed professional communication between prescriber and pharmacy staff. Some pharmacy staff dispenses according to the patient's wish. This should not be practiced as patients are not drug specialists and it's not clear whether the prescriber has purposely prescribed that CR tablet.

Considering the results, it can be concluded that pharmacy staff in Kandy municipal area of Sri Lanka will act in various ways when they get a prescription according to which CR tablets should be broken. This may be due to lack of knowledge as only 3 out of fifteen are qualified pharmacists. Therefore, the pharmacy staff should be encouraged to obtain professional qualifications. In addition continuous professional development programs should be organized for pharmacy staff to impart knowledge on new pharmaceuticals.

COMPARISON OF THE GLYCAEMIC INDEX OF STRING HOPPER FOOD AND STRING HOPPER MEALS IN CONTROLLED DIABETICS

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Scientific data on postprandial glycaemic response of common meals is essential when formulating diets. With this objective, this study was conducted on the glycaemic index of a meal consisting of white and brown rice flour string hoppers with different dishes (string hopper meal) and string hoppers alone (string hoppers food) in controlled diabetes.

Fourteen controlled diabetics from Teaching Hospital of Peradeniya (20-60 years, M: F, 6: 8) were involved in the study. White rice and brown rice flour string hoppers (WRSH and BRSH) were given alone and with one of the following dishes on any one occasion; coconut gravy+coconut *Sambol* (*Cocosnucifera*) (WRSHCSKH & BRSHCSKH), lentil / Mysoor/ Masoor dhal curry (*Lenseculinaris*) (WRSHL & BRSHL), legume/ beans curry (*Phaseolus vulgaris*) (WRSHB & BRSHB) and fish/ Indian scald curry (*Decapterusrusselli*) WRSH & BRSHF. Each serving contained 50g of available carbohydrates. Glycaemic index (GI) was calculated by standard method.

The mean age and body mass index of diabetes was 46±9.5 years, 27.6±4.7kgm⁻² respectively. The GI of string hoppers food and string hoppers meals in controlled diabetes were WRSH, BRSH, WRSHCSKH, BRSHCSKH, WRSHL, BRSHL, WRSHB, BRSHB, WRSHF, BRSHF were 89±2.6, 84±1.4, 81±7.3, 61.2±4.9, 55.8±11.1, 49.1±7.5, 44.6±13, 42.4±13.4, 59.9±9.6 and 47.7±8.3 respectively.

Compared GI of BRSH and WRSH without dishes, there were no significance differences showed in high GI value. Adding dishes to string hoppers lowered the GI whether WRSH or BRSH. The coconut gravy+coconut *Sambol* showed a high GI value with WRSH and medium GI value in BRSH. In controlled diabetics fish curry and lentil curry resulted in medium GI value, and beans curry resulted in a low GI in both WRSH & BRSH. Except menu with coconut gravy+coconut *Sambol* and fish curry there were no significant differences ($p<0.05$) in GI between WRSH and BRSH meals. The legume meal showed a significant reduction in GI in both WRSH and BRSH meals and could be recommended for diabetes.

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SAFETY EVALUATION OF ANTICARCINOGENIC α – ELEOSTEARIC ACID RICH FAT EXTRACTED FROM *MOMORDICA CHARANTIA* (BITTER MELON) SEEDS USING A MOUSE MODEL

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Momordica charantia (bitter melon, *karawila*) is a well - known vegetable available in Sri Lanka. Seed portion of bitter melon contains a conjugated trienoic fatty acid named α - Eleostearic acid (α – ESA; 18:3;9c,11t,13t). *In vitro* and *in vivo* studies strongly suggest that it has a potent anticarcinogenic activity. However toxicological evaluation of this fat source has not been well documented and it is a major impediment for conducting animal studies as well as clinical trials.

To evaluate the safety of ingesting fat from bitter melon seeds, a total of 40 eight-weeks-old female mice were divided into four groups as Control 1(C1), Control 2(C2), Test 1(T1) and Test 2 (T2). Mice were given feed and water *ad libitum*. C1 was not given any supplement and C2 was given coconut oil supplement. The seed fat was administered to T1 and T2 at the rates of 1.5% and 3.0% as a percentage of food intake for 21 days, following the 7 days of acclimatization period. Behavioral and feeding patterns of mice were recorded daily. Body weights were taken once a week. WBC/DC was performed as a hematological investigation. Serum biochemical analyses were also performed.

Neither group exhibited alterations in behavior. Feed and water intakes were comparable among four groups. However, average body weights of mice of C1 and T1 at the day-21 were significantly higher as compared with that of C2 and T2 groups. Average weights of all organs measured in the study were comparable among the experimental groups. Furthermore, values related to hematological and serum biochemical parameters were also comparable among the groups indicating the absence of any toxic effect on mice.

Oral administration of bitter melon seed fat did not result in any kind of behavioral alterations or abnormalities in food or water intake. Significant changes observed in body weight may have been due to the high appetite of T1 group mice and low appetite of C2 mice. Comparable values in hematological and biochemical parameters provide the evidence for safety of continuous ingestion of seed fat of bitter melon.

Fat rich in α - ESA, extracted from bitter melon did not result in any adverse effect in mice. These findings pave the way for further experimental trials with animal models and human subjects.

METRIC AND NON-METRIC CHARACTERISTICS OF THE FEMUR IN A CONTEMPORARY SRI LANKAN POPULATION

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Skeletal features have been valuable in the assessment of affinities among human populations. Anthropometric studies reveal that skeletal features of the femur are affected by dietary, hereditary, climate, geographical factors and factors related to lifestyle of the population. The main objectives of the present study were to determine metric and non-metric variations of the femora in a contemporary Sri Lankan population and to compare the data with those of other world populations.

Thirty-nine femora of unknown sex were obtained from the Faculty of Medicine (27) and Faculty of Dental Sciences (12), University of Peradeniya, Sri Lanka. Osteometric board, sliding caliper, measuring tape and goniometer were used to measure the maximum length, anterior-posterior and mediolateral diameter of the midshaft, maximum diameter of the head, circumference of the midshaft, sub trochanteric anterior-posterior and mediolateral diameter to the nearest 0.01mm, by one investigator. The presence of the Allen's fossa, Poirier's fossa, plaque formation, hypotrochanteric fossa, exostosis in the trochanteric fossa and third trochanter were also assessed.

The mean maximum femur length was 428.7 ± 26.35 mm. The mean diameter of the midshaft anteroposteriorly was 26.69 ± 2.20 mm and mediolaterally was 24.67 ± 1.78 mm. The transverse diameter of the head of the femur anteroposteriorly was 41.0 ± 3.03 mm and mediolaterally was 41.0 ± 2.37 mm, whereas the circumference of the midshaft gave a mean of 88.7 ± 8.39 mm. Collo-diaphyseal angle ranged between 113.25° to 133.8° with a mean of $124.24 \pm 5.0^\circ$. Platymetric index was also assessed and was obtained by multiplying the ratio between anterior-posterior and mediolateral subtrochantheric lengths by hundred. It was 84.18, which suggest the femora belong to platymetric group. Considering the non-metric measurements, Allen's fossa and Poirier's fossa were not seen in the present sample and the occurrence of hypotrochanteric fossa was observed to be moderately high (38.46%). In addition, plaque formation, exostosis in the trochanteric fossa and third trochanter were seen as 10.25%, 2.56% and 2.56%, respectively.

In conclusion, metric data of the femur in the present contemporary Sri Lankan sample showed closer affinities with those of Indians than other populations compared. However, the prevalence of non-metric traits studied in the present sample was considerably lower than those of Indians probably, due to smaller sample size used in the present study.

AN EVALUATION OF THE EFFECT OF DEVELOPMENT TIME ON X-RAY FILM DENSITY

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Film processing is a strict science governed by rigid rules of chemical concentration, temperature, time, and physical movement. Studies have shown that processor variability is the single most important cause of retakes. Whether processing is done by hand or automatically by machine, excellent radiographs require a high degree of consistency. Because of that, the importance of the processing conditions has become more evident over the last decade. Developing time, developing chemicals and their temperature are considered as some factors to affect the optical density of the radiographic films. Aim of this study is to find out the effect of the different development time on X-ray film density to remove any discrepancy incurring due to processor related variables.

Hundred double emulsion films were irradiated and were produced . 100 sensitometric strips with 21 steps each.

Film was processed with different processing time with a gap of 10 s. Optical density was measured at 5 places and calculated the mean net density value .Base plus fog densities of each film and densities of the 3 un-irradiated areas were also measured.

Significant changes were observed in the base plus fog values and the optical density values of the X-ray films at varying development times. Lowest base-plus-fog of 0.17 has measured in the 10 s developing times and the highest base-plus-fog of 0.36 has measured in the 150 and 160 s. The observed changes of average net density values were in the range of 1.95 to - 0.00267. The highest net density value was observed on 21st step of sensitometric strips with the developing time of 50 s. The results of the present study indicate that there is a positive relationship between the base plus fog densities with the developing time when the other factors were controlled. At 70 s, the base plus fog density value was exceeded the limit of 0.25 which is clinically accepted.

Net density value of the present study was within the accepted limit for the selected development time periods. Effect of the different development time on X-ray film density (optical density) to remove any discrepancy incurring due to processor related variables which may spoil the patient's film images and contrast, leading to retake is minimal.

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PATTERN OF LOWER EXTREMITY INJURIES AMONG MALE SCHOOL FOOTBALL PLAYERS IN KANDY EDUCATIONAL ZONE

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This study aimed to find out the prevalence of lower extremity injuries among male school football players in Kandy educational Zone. Football players who have been in the field at least for 1 year were included in the study. Data including the patterns of injuries and treatment options following injuries were gathered from 168 players through an interview based questionnaire and through a musculoskeletal assessment of the players who had experienced the injuries.

The prevalence of having an injury among football players was 51.78%. The highest prevalence was observed in the under 17 age group (60.42%) and followed by under 19, under 15, and under 13 age groups. There was a negative relationship between warming up and prevalence of injuries. The study showed that the sweepers and strikers are more prone to injuries with a prevalence of 66.67% and 60.87% respectively. Prevalence of injury was less (25%) among forward players. Most of the injuries occurred were sprain and strain injuries (70.11%) followed by bruise (21.84%) and dislocations (8.05). According to the findings, highest prevalence was observed in Ankle (34.48%) followed by Knee (29.89%). The prevalence of injuries to the leg was equal to that of the foot (10.34%). Injury occurrence was minimal in toes, feet and hip. More injuries were reported during training (73.56%) than during competitions. Direct injuries accounted for 67.82% whereas indirect injuries were 28.74%. Overused injuries were minimal. Most of the players had preferred the option of self treatment (36.78%) followed by consulting a medical practitioner (29.9%). Although around two weeks of rest time could prevent delay in recovery, most of the players returned to play before that.

This study shows the importance of adhering to injury prevention measures and proper rest time following an injury.

ELUCIDATION OF THE RELATIONSHIP BETWEEN A BONE TURNOVER MARKER, CTX, AND SOME TRACE MINERALS

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Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fractures. It is considered to be a “silent killer” because it occurs swiftly and depletes as much as 40% peak bone mass before being detected, and there are no warning signs for osteoporosis. Osteoporosis can be debilitating, expensive and even lethal.

The analysis of degradative products of collagen type 1 (bone specific collagen) such as cross-linked C-telopeptide of type 1 collagen (CTX) in serum and/or urine as bone turnover markers (BTMs) are used as reliable diagnostic tests for detection and monitoring of osteoporosis, fracture prediction and in monitoring and evaluation of drug intervention during clinical treatment. CTX is not metabolized in serum and is excreted unchanged by the kidneys, therefore CTX directly reflects bone matrix collagen degradation. The trace elements like Fe, Cu, Cr, Ni, Pb, Li, Mn, Zn and Co may act as cofactors for enzymes, receptors, and cytokine activities to maintain healthy bone. The involvement and functions of trace elements in osteoporosis is not yet clearly elucidated. It is now known that fluoride (F) can reduce osteoporosis and dental caries. In our recent studies we found that elements like Fe, Cu and Ni show a significant decrease in concentration in the bones during osteoporosis in mouse models. Therefore a complete understanding of the trace elements in bone metabolism is timely, necessary and important for clinical intervention and development of therapeutic agents for bone disorders like osteoporosis, and detailed knowledge on the homeostasis of trace elements in bone will bridge a gap in knowledge.

Given this background, the aim of this study is to the relationship between the clinical marker CTX and the reduction of trace elements Fe, Cu and Ni in bone tissues due to osteoporosis. To this end an established ovariectomy (OVX)-induced osteoporotic mouse model was used. Twenty-four 12-week-old female BALB/c mice were randomly divided into four groups (n=6). Two groups were subjected to the OVX-operation and the other two were subjected to sham operations. An OVX-operated group and a sham-operated group were sacrificed at day 0 and the rest after four weeks. Serum samples were collected just before sacrifice and long bones were collected after sacrifice. All the serum samples were subjected to enzyme immunoassay (EIA) to detect CTX while long bones were subjected to atomic absorption spectrometry to detect the trace elements. At the fourth week the increase of serum CTX level confirmed the osteoporosis. Significant decreases in the Fe ($p < 0.005$), Cu ($p < 0.005$), Ni ($p < 0.005$) were detected at the osteoporosis condition. These data suggests a reduction of trace elements with the increase of CTX in serum. Furthermore, establishing a possible relation between the trace elements (Fe, Cu and Ni) and CTX is important to better understand the correct clinical picture of bone, and to analyze the effectiveness of the treatment in clinical practice. Microelements could be used as possible drug targets in future, for the amelioration of osteoporosis. However, further studies are necessary to clarify the mechanisms of trace elements in osteoporosis.

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STUDENTS' PERFORMANCE AND PERCEPTIONS WHEN USING DIGITAL CADAVER IMAGES VERSUS COMPUTER GRAPHICS IN LEARNING ANATOMY

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Still images of cadaveric material and graphic designs have been used in various computer-based anatomy learning resources. However, empirical evidence indicates that learners with poor spatial ability may be hampered severely by some types of sophisticated multimedia graphics, animations, highlighting the importance of research into the efficacy of e-learning instructional design for anatomy education. This study aims to investigate students' performance and perception on e-learning resources containing digital cadaver images *vs* computer graphical representations.

Two e-learning resources using digital pictures (Model A) and computer graphics (Model B) were prepared to study the "Structural Organization of the Brain" and provided them for two groups of first year dental students (n=53). Both groups were assessed using theory and practical tests. After the tests, both e-learning resources were made available to all students through online and offline viewing for two weeks. Perceptions of students towards two resources were assessed using a self-administered questionnaire.

Students who used the model A received higher scores than the model B for both the theory and practical tests. However, a statistically significant difference was noticed only for the practical test between two groups ($P=0.03$). The majority (75%) of students suggested that graphic pictures are ideal for identifying anatomical relations while digital pictures are good for the practical test. Further, regarding the students' view of best picture material to learn anatomy, 11 students have said "the graphic picture is good since it helps to understand the relationship between different structures of the brain" 10 students have said "the digital picture is good since it is similar to the true view and helpful for the spot exam" and 7 students have said "both the graphic and digital pictures are important since they can have better understanding and clear view when they use both graphic and digital pictures together".

In comparison of two picture materials, it was found that graphic pictures are more helpful than digital pictures to identify the anatomical relationships of different structures of the brain and to visualize the structures of the brain three dimensionally. Digital pictures are important to identify the structures in the practical spots.

The results suggest that both the graphic and digital pictures are necessary for learning anatomy depending on the intended outcome of students' learning. However, further studies are necessary with larger groups of students to confirm this conclusion.

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EVALUATION OF ROOT AND ROOT CANAL MORPHOLOGY OF PERMANENT FIRST AND SECOND MANDIBULAR MOLARS USING CONE BEAM COMPUTED TOMOGRAPHY (CBCT) IN A SRI LANKAN POPULATION

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Recognition of variations in root canal morphology is essential for the success of endodontic diagnosis and treatment. The root and root canal morphology of mandibular teeth present clinical complications that often jeopardize endodontic treatment. Morphology of the root canal system of the mandibular molars may vary according to ethnic differences, age, gender and study design. Aim of this study was to evaluate root and root canal morphology in permanent 1st and 2nd mandibular molars using CBCT in a Sri Lankan population.

All the mandibular CBCT scans taken at the Division of Oral Medicine and Radiology, Faculty of Dental Sciences, University of Peradeniya in patients who were between 20-30 years of age were reviewed. The CBCT scans were taken with the Pax-Duo 3D (Vatech Inc, Korea) machine. All mandibular 1st and 2nd molars were evaluated in axial sections from pulpal floor to the root apices to identify the number and morphology of roots and root canals. Gender, race, side of the tooth, number of roots and number of canals in each roots were recorded. Root canal morphology was recorded according to the Vertucci Classification. C-shaped roots and C-shaped canals of lower second molars were also assessed

Hundred and twenty four 1st molars were included in the study. Sixty five (52.4%) of them were from the right side. Other than 3 Muslim patients, all the others were Sinhalese (98.4%). Majority was female (67.7%). Almost all the teeth had one mesial root and one distal root (97.6%). Two mesial canals (74.2%) and one distal root canal (94.4%) were the commonest. The commonest root canal configuration in the mesial root was type IV (75.8%) followed by type II (18.5%). In the distal root it was type I (90.3%) followed by type II (8.1%). There were no C-shaped roots and root canals in the sample. There was no statistically significant difference between left/right side and male/female with number of roots, number of root canals and canal configuration in the first molars.

Among 241 second molars in the study, 123 (51%) were from the right side. Other than 12 Muslim patients and 3 Tamil patients, all the others were Sinhalese (93.8%). Majority were female patients (63.1%). One root was present mesially (88%) and distally (90%). One canal was commonly present in both mesial (58%) and distal (86.3%) roots. The commonest root canal configuration in the mesial root was type IV (34.9%) followed by type II (33.6%). In the distal root, it was type I (88%) followed by type II (1.2%). The presence of C-shaped roots and C-shaped root canals were 10% each in the sample. There was a statistically significant difference with gender and canal number and canal configuration in mesial and canal number in distal roots.

In the first molars with two roots, two mesial canals with the canal configuration of type IV and one distal canal with the canal configuration of type I was the commonest presentation whereas in the second molars, C-shaped roots and canals were seen in 10% of the cases. Gender has an influence in the canal number and configuration of second molars.

EFFICACY OF DIFFERENT NON-SURGICAL METHODS IN THE MANAGEMENT OF NON-VITAL TEETH WITH LARGE PERIAPICAL LESIONS

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Bacterial infection of the dental pulp may lead to periapical lesions. They are generally diagnosed either during routine dental radiographic examination or following acute pain in a tooth. The incidence of cysts within periapical lesions varies between 6% and 55%. Several methods such as conservative root canal treatment without adjunctive therapy, decompression technique, intra-canal dressing with calcium hydroxide, placement of Mineralo-Trioxide Aggregate (MTA) and placement of Biodentine have been proposed to treat non-vital teeth with radicular cyst or cyst like lesions.

The main objective of the present study was to evaluate the efficacy of different non-surgical methods in the management non-vital teeth with large periapical lesions.

Patients exhibiting well circumscribed periapical lesions of more than 5mm in diameter on a pre-operative periapical radiograph and requesting endodontic treatment were selected. They were categorized into 5 groups and managed by the following means; group 1; Conservative root canal treatment without adjunctive therapy, group 2; Decompression through the root canal technique, group 3; Calcium hydroxide, group 4; Treatment with MTA and group 5; Treatment with Biodentine. A total of 120 teeth were managed giving a sample size of 24 for each treatment group. After the treatment, the patients were recalled every 3 months for clinical and radiographic reassessment.

Complete periapical healing was seen in 62% of group 1, 63% of group 2, 88% of group 3, 90% of group 4 and 84% of group 5. Group 3 took the longest treatment time and most number of visits compared to all other groups. In group 1 and 2, enlargement of the lesions was seen in 16% of the teeth whereas in group 3 and 4, none of the teeth showed enlargement of the periapical lesions. In Group 5 one tooth showed an enlargement. In group 3, 4 and 5 all the teeth which did not show complete healing had evidence of shrinkage of the lesions.

Teeth in groups treated with Calcium hydroxide, MTA and Biodentine showed a superior percentage of healing compared to direct obturation and decompression methods. On average these methods showed a rate of complete resolution as observed on radiography in 88% of the cases. MTA showed a slightly superior rate of complete resolution compared to the other two medicaments. In conclusion, MTA, Biodentine and Calcium hydroxide are equally effective in the non surgical management of large periapical lesions.

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CULTURALLY ACCEPTABLE PRACTICES FOR MANAGEMENT OF DIABETES MELLITUS AMONG THE TAMILS LIVING IN THE BATTICALOA DISTRICT

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Understanding the influence of culture on health care practices is likely to improve the outcome of diabetes mellitus. Integrating cultural constructs into diabetes care that targets ethnic groups may result in greater patient satisfaction as well as better disease outcomes. The purpose of this study was to explore the experiences of physicians and dieticians regarding the culturally acceptable practices for self-management of diabetes mellitus (DM) among the Tamils with DM in Batticaloa district.

Two consultant physicians and two dieticians who treat the diabetic patients of Tamil ethnicity were recruited voluntarily. Descriptive qualitative methodology was used to understand the culturally acceptable practices for self-management of DM. The data were collected by in-depth interview using audio recording, and verbatim transcripts were analyzed on the basis of content analysis.

Three themes were generated including healthy eating, being physically active and risk reducing behaviors. 'Food that give better and poor glycemic control', 'acceptable frequency of eating' and 'amounts of each variety' were used to explain the healthy eating. Under being physically active, there was 'best physical activity' and 'best way to do physical activity'. Risk reducing behaviors were described by concepts such as 'healthy coping skills', 'educating the patient' and 'compliance with treatment'.

These finding would contribute to better self-management of diabetes mellitus among Tamils if they adhere to the acceptable practices by modifying lifestyles and practices, which would enable health care workers to assist diabetics for better self-management. The results will also be useful to guide planning of large scale studies in future.

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KNOWLEDGE AND ATTITUDES ON DIABETES MELLITUS IN A RURAL POPULATION IN SRI LANKA

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Diabetes mellitus is a non-communicable disease causing high mortality and morbidity, with a worldwide prevalence of 8.3% and a Sri Lankan prevalence of 10.3%. The prevalence of diabetes is increasing alarmingly due to life style changes and obesity. Early diagnosis and initiation of treatment, with maintenance of glycaemic control, is essential to prevent progression to morbid complications. It has been hypothesized that people with poor knowledge and attitudes about the disease tend to have poor medication adherence and are less likely to attain treatment goals. The aim of this study was to assess the knowledge and attitudes on diabetes mellitus among the general population.

This cross sectional study evaluated 1693 subjects, including diabetic patients attending the diabetes clinic and people of different educational levels, and students and teachers in a rural school. Participant knowledge and attitudes on diabetes mellitus, was assessed with the use of a self-evaluation questionnaire.

Our study population included a total number of 1689 subjects, among whom 1261 (74.6%) were students, 247 (14.6%) were diabetic patients and 181 (10.7%) were school teachers. The study sample consisted of 48.9% males and 51.1% females. The knowledge scores of the study population regarding diabetes mellitus were 6.9%, 36.8% and 56.3% with poor, average and good knowledge respectively regarding diabetes mellitus. Attitude regarding diabetes mellitus was poor in 7.7%, average in 25.9% and good in 74.1 % of subjects. 57.49% of students in the study sample had a good knowledge and attitudes regarding diabetes mellitus, and the value increased to 80.68% among Teachers. Even though 69.64% of diabetic patients had a good knowledge and attitude regarding the disease, surprisingly 15.7% of diabetic patients had poor scores.

A higher percentage of diabetic patients had good knowledge and attitudes regarding the disease, but a considerable proportion also had poor knowledge and attitudes, which is an important drawback in patient management and which is likely to hinder prevention of progression to complications. Patient education and counseling plays an integral role in the management of diabetes mellitus. Since diabetes mellitus is a common disease among the general population, and since it requires an early diagnosis, education about the disease should commence from school level to improve outcome on the whole.

PLASMA CELL MUCOSITIS AFFECTING ORAL MUCOSA: A REPORT OF 11 CASES

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Plasma cell mucositis (PCM) is a rare idiopathic inflammatory condition showing benign plasma cell proliferation with erythematous mucosa and varying surface appearances affecting oral, upper respiratory and genital mucosae. Final diagnosis should be achieved by clinico-pathological correlation following exclusion of other similarly presenting diseases. Different treatment modalities such as steroids, calcinurin inhibitors, cryotherapy, laser and surgical excision have been used but with varying response. Therefore, Plasma cell mucositis presents a challenge in both diagnosis and treatment. The main objectives of this study were to report eleven new cases of PCM and discuss their histological variations and management to aid correct diagnosis and treatment.

Eleven patients who initially presented to the department of Oral Medicine, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka, with the complaint of oral discomfort and difficulty in swallowing for 3 to 9 months duration and finally confirmed as PCM following histopathological investigations, were taken as the cases and their clinical presentations and histological features were analyzed. These patients were treated with corticosteroids and antifungals and closely followed up to see the response.

Out of the eleven patients there were 4 males and 7 females with the male to female ratio of 1:1.75 and their age ranges from 37-70 years with the mean age of 57.5 years. The most common site affected was lower lip followed by tongue. Clinically most of them showed erosions, ulcerations, erythematous areas affecting single or multiple sites. Histologically the predominant feature was, a dense infiltration of plasma cells in the upper corium extending to deeper muscles and minor salivary tissues. Additionally, 64% of them showed features of lichenoid reaction due to indigenous topical applications that they had received before the biopsy. Most of the patients responded well to the steroid and antifungal treatment. Prognosis of PCM is relatively favorable and progression to plasma cell neoplasm has never been reported. Most cases are described as requiring multiple biopsies and having many other investigations and this was the situation in the present series as well, and majority of them have been seen by several clinician and had several biopsies. In conclusion final diagnosis of PCM should be achieved by clinico-pathological correlation.

AN ANALYSIS OF CERVICAL LYMPH NODES METASTASIS IN ORAL SQUAMOUS CELL CARCINOMA: RELATIONSHIP BETWEEN CLINICAL AND HISTOPATHOLOGICAL STATUS OF NODAL METASTASIS

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Oral squamous cell carcinoma (OSCC) is one of the common cancers in the world and it is the commonest cancer in males in Sri Lanka. Annual estimated incidence in the world is around 275000 for oral and 130300 for oro- pharyngeal cancer. OSCC is a major oncological problem in many regions of the world, where tobacco habits are practiced in the form of smoking and chewing. The prognosis of patients with OSCC is influenced by the presence of lymph node metastasis. However, the relationship between prognosis and clinico-pathological features in OSCC has not been fully explored in Sri Lankan patients. According to the literature, there is approximately 33% of metastasis (occult) in clinically negative head and neck SCC. Surgical management of N0 neck is done depending on the primary site and is mostly therapeutic. The presence of lymph node metastases is associated with a dramatic reduction of the survival rate in oral cancers. Lymph nodes, histologically positive for OSCC provide one of the simplest and perhaps the most important markers in head and neck cancer. The main objective of the present study was to find out whether there is any discrepancy between clinical nodal status (cN) and TNM status in a group of OSCC patients with histological evidence of nodal metastasis and pathological TNM (pTNM). Further, we assessed the relationship with the results of ultrasound scan (USS) status of cervical lymph nodes.

This prospective study sample comprised of 35 patients with OSCC who had surgical excision of the lesion including cervical lymph nodes. The cases were selected from February 2012 to January 2013. Ethical clearance was obtained from the ethical and research committee of Faculty of Dental Sciences (No.FRC/FDS/UOP/E/2014/27). Patients who had previous surgery and/or had chemo or radiotherapy were excluded from the study. Details pertaining to age, gender, primary site and clinical TNM status were recorded. USS report of the neck was also recorded in each patient. Pathological information regarding lymph nodes was also gathered. The age of the 35 patients ranges from 30yrs to 76yrs and the male to female ratio was 3.4:1. The common sites of oral cancer were buccal mucosa and tongue. Out of the total sample, 68.6% cases (26 out of 35) were clinically N1 and histologically it was 40% (14 out of 35). Twenty tumours showed clinical T4N1M0, and 7 of them showed pT4N1M0 and the rest was negative for tumour metastasis. According to the USS results 20% of the cases showed nodal positivity that confirmed with histopathology. Nearly 35% of the cases were unable to confirm pathologically, although USS positive.

Although clinical TNM is an important tool it is necessary to confirm the presence of neck metastasis before planning the neck management. One possible way is to perform USS guided fine needle aspiration cytology (FNAC). As this is a preliminary study we will analyze all criteria such as clinical and pathological TNM, USS and the results of FNAC in a large cohort of patients.

α -GLUCOSIDASE INHIBITORY ACTIVITY OF *SYZYGIUM CUMINI* LEAF EXTRACTS

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A large number of medicinal plants are used in the treatment of diabetes mellitus. *Syzygium cumini* is one such plant used in the management of diabetes. Diabetic hyperglycemia results either from an absolute deficiency in insulin or defective insulin action or both. An important therapeutic approach to prevent postprandial hyperglycemia is to delay the digestion and absorption of carbohydrates through inhibition of enzymes such as α -amylase and α -glucosidase. Inhibitors of these enzymes are known to lower postprandial glucose levels. The aim of this study was to determine the inhibitory effects of *in vitro* α -glucosidase of *Syzygium cumini* leaf extracts.

Syzygium cumini leaves were collected and authenticated. The hexane, ethyl acetate, methanol and water extracts were prepared from dried powder. The α -glucosidase inhibition was determined using p-nitrophenyl α -D-glucopyranoside and α -glucosidase from *Saccharomyces cerevisiae*. Suitable controls and blanks were used. Acarbose was used as the standard inhibitor. Analysis was carried out four times in duplicate. Results are expressed as mean \pm SD. Half maximal inhibitory concentration (IC₅₀) value for each extract was obtained using a series of extract concentrations.

Hexane and ethyl acetate extracts had lower yields (<5%). Methanol extract had the highest yield (17.25%) and followed by the water extract (9.5%). The hexane extract showed 57% α -glucosidase inhibition at 0.01 mg/ml concentration. Other three extracts showed more than 80% inhibitory activity. All four extracts had very low IC₅₀ values (<8 μ g/ml), among them hexane and ethyl acetate extracts showed higher values (\geq 3 μ g/ml) than methanol and water extracts (<1 μ g/ml).

Plant extracts with α -glucosidase inhibitory activity are likely to be helpful in the management of diabetes. All four extracts tested in this study proved their ability to work against α -glucosidase. Based on the yield and the inhibitory activity, highest recovery of inhibitory compounds was obtained with the methanol extract which was followed by water extract. Comparatively lower activity was recovered in hexane extracts. Amylase inhibitory activities reported previously also showed highest recovery in methanol fraction which was followed by the water fraction with no amylase inhibitory activity in hexane fraction. The inhibitory activities of the extracts seem to be increasing with the polarity of solvents used for extraction which may be due to the polar characteristic of the inhibitors. Further studies are needed to identify the α -glucosidase inhibitors from *Syzygium cumini*.

Syzygium cumini leaf extracts showed strong α -glucosidase inhibitory effects. All four extracts showed IC₅₀ values below 8 μ g/ml for α -glucosidase inhibitory activity with the lowest being 0.69 μ g/ml in the water extract.

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THE USEFULNESS OF TUMOUR THICKNESS IN PREDICTING NODAL METASTASIS OF ORAL SQUAMOUS CELL CARCINOMA (PRELIMINARY STUDY)

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The indication for elective neck treatment is mainly based on the expected risk of occult metastases. There are still many doubts concerning the best way to approach N0 neck disease in early-stage lesions (T1 and T2). Many parameters have been studied to identify N0 patients with a high likelihood of harboring occult node metastases or of having them developed. Tumour thickness has been shown to be one of the most important features in predicting lymph node metastases in oral cancer. Therefore, it can help in decision-making with regard to management of the primary tumour and neck. Other prognostic indicators of the tumour are age, sex, race, habits, clinical parameters (TNM stage, site) and histopathological parameters such as the pattern of invasion, perineural invasion and vascular invasion. Several studies have focused on tumour thickness since 1986. Most of the studies have discussed the relationship between tumour thickness of tongue and floor of the mouth and metastasis. So far, in Sri Lanka we do not have any studies or reported data on tumour thickness and metastasis although oral squamous cell carcinoma (OSCC) is the commonest cancer in men in this country. The aim of this study was to evaluate the relationship between tumour thickness, pattern of invasion and nodal metastasis of both buccal mucosal and tongue OSCC.

One hundred and ninety patients who underwent surgery for cancer of the tongue and buccal mucosa with neck dissection were retrospectively studied. All the cases were selected from archives of the Department of Oral Pathology, Faculty of Dental Sciences, University of Peradeniya from March 2010 to March 2015. Demographic data such as age, gender were recorded. Clinical information, mainly tumour size (T) was reviewed. On histological sections, the tumour thickness was measured using an optical micrometer with a graticule. The depth (to the nearest mm) was taken from an imaginary line at the surface of the healthy oral mucosa to the deepest point of tumour invasion. Nodal status and pattern of invasion were also recorded. There were 140 males and 50 females with the male to female ratio of 1.8:1. The samples were from buccal mucosa (121) and from tongue (69). Tumour size ranges from T1-T4 and majority of the tumours were T4 in size. Out of 56 T1 and T2 tumours only 2 cases had lymph node metastasis (3.6%) irrespective of the depth of invasion. Depth of invasion ranged from 1.5mm to more than 11.5mm. T3 and T4 tumours showed 28.8% and 44% of metastatic rate respectively. Measurable depth in a glass slide ranges from 1.5mm to 22.5mm. For tongue carcinoma, the risk of metastasis in the neck with tumour thickness of 4mm or less was 15.4% (2 out of 13), whereas when tumour thickness was 4.25mm or more this risk was 35.7% (20 out of 56). For buccal mucosal OSCC tumour thickness of 4mm or less showed the risk of metastasis of 12.5% (2 out of 16) and more than 4.25 mm cases showed 26.7% of risk to develop metastasis (28 out of 105). Pattern of invasion showed apposite correlation with metastasis. Pattern IV showed higher metastatic rate compared to pattern I and II in both tongue and buccal mucosal tumours. In conclusion tumour thickness is an important tool to predict metastasis together with pattern of invasion. Tumours that have less than 6mm thickness showing pattern of invasion i and ii, can apply wait-and-see policy in managing the neck. It is advisable to follow the patient up regularly.

COMPARISON OF SERUM ELECTROLYTE CONCENTRATIONS MEASURED IN ARTERIAL BLOOD GAS ANALYSER AND ION SELECTIVE ELECTRODE ANALYSER

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The fluid and electrolyte (such as Na⁺, K⁺ and Cl⁻, etc.) abnormalities must be measured accurately and as soon as possible to recommend medications for the critically ill patients. The most common approach of measuring electrolytes in the human body is using serum electrolyte concentrations. Ion Selective Electrode analyser (ISE) is the gold standard method for measuring serum electrolyte concentrations and requires a clotted sample of blood which would require at least 30 minutes.

Arterial Blood Gas (ABG) analyser which is a common device in Emergency Trauma Units (ETUs), can measure electrolyte concentrations in whole blood. The results can be obtained often in less than five minutes. However the data on comparability of electrolyte measurements using ABG analyser versus ISE is limited in a local setting. Previous work had shown significant differences in Sodium (Na⁺) and Potassium (K⁺) values. The samples used too were different in previous studies; an arterial blood sample for ABG analyser and a venous blood sample for ISE analyser.

In our study we assessed the comparability of electrolyte measurements (Na⁺ and K⁺), using an ABG analyser versus ISE technique. We used heparinized arterial blood samples from 67 patients who were admitted to ETU of Teaching Hospital Karapitiya (THK), to measure the electrolyte concentrations using both methods. Our results showed that the ABG analyser and the ISE analyser yield equivalent Na⁺ values (no significant statistical difference with p>0.05). However a statistically significant difference (p< 0.05) was observed between K⁺ values. The ABG analyser values showed positive correlation when compared with the ISE values for both Na⁺ and K⁺. Then Cohen's effect size (d) was calculated to measure the clinical significance. Values were less than 0.2 (<0.2), for both Na⁺ and K⁺ and the differences between the two mean values are less than 0.2 standard deviations for both analytes. Therefore the difference between the two analysers is low clinically significant for both analytes.

EVALUATION OF DISSOLUTION PROFILE AND PHYSICAL PARAMETERS OF METFORMIN HYDROCHLORIDE SUSTAINED RELEASE TABLETS IN THE SRI LANKAN MARKET

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Type 2 diabetes mellitus (T2DM) is a chronic progressive disorder characterized by increased insulin resistance and defective insulin secretion. Metformin hydrochloride (MH) is a biguanide, used as a first line drug for the treatment of T2DM. The highly water soluble form of MH has low bioavailability, a short and variable biological half life (1.5-4.5hours) and requires high frequency of administration to maintain effective plasma concentration. The frequent administration and side effects lead to decreased patient compliance. Therefore, sustained release tablets are used to prolong duration of action and improve patient compliance. The dissolution profile and physical properties of the MH tablet are parameters that influence the efficiency of treatment of T2DM.

MH sustained release tablet samples from seven different companies were selected for this study. Twenty tablets from each sample were tested for weight variation according to the BP method and ten tablets from each sample were tested for friability according to USP method. Ten tablets from each sample were tested for thickness, diameter and hardness. Six tablets from each sample were evaluated for their drug releasing pattern according to the USP method by using dissolution tester. The release was monitored in KH₂PO₄ buffer medium (pH 6.8) at 37°C using apparatus 2 (paddle) of dissolution tester. An aliquot was withdrawn at the end of one, three and ten hours and released drug content was determined through measurement of absorbance at 232 nm in a uv-visible spectrophotometer.

The weight variation of all seven market samples were within 5% of average weight. The friability of six out of seven market samples was less than 1% for 100 rotations. The hardness, thickness and diameter of all market samples were within acceptable limits. The drug release of six market samples at end of first one hour (USP limit – 20 to 40%) and ten hours (USP limit – less than 85%) were within limits, but drug release at the end of three hours (USP limit – 45 to 65%) was a little above the limit for three market samples out of seven.

The weight variation of the seven market samples fulfils the requirement of standard limits of BP. One market sample out of seven was out of USP limit in friability test due to its low hardness. The dissolution profile of seven market samples was more or less within the standard limit of USP. It can be concluded that the drug releasing pattern did not have correlation with friability.

A COMPARISON BETWEEN SODIUM FLUORIDE AND ACIDIFIED BLOOD SAMPLES TO PREVENT *IN-VITRO* REDUCTION OF BLOOD GLUCOSE

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Sodium fluoride is the most widely used preservative in the *in vitro* preservation of blood glucose. However, a significant reduction in blood glucose concentrations in the NaF added samples has been revealed by previous studies and many new emerging techniques have been proposed to counter this drawback. This study was carried out in order to validate the use of sodium fluoride as a preservative of blood glucose and to decide on a simple and more reliable alternative method for preserving blood glucose concentration using citric acid.

A total of 103 volunteers participated in this study. Three milliliters (3 ml) of fasting or random blood samples were obtained from each participant and five different glucose determinations were made based on samples obtained at the same time, but handled differently. These five determinations of glucose included the immediate glucose concentration in plain tube, 1st hour glucose concentrations in NaF/K₂C₂O₄ (1mg/3mg, 1.0 ml Draw) containing bottles and citric acid/EDTA-2Na (5mg / 2mg, 1.0 ml Draw) containing bottles and the 2nd hour glucose concentrations in NaF/K₂C₂O₄ (1mg/3mg, 1.0 ml Draw) containing bottles and citric acid/EDTA-2Na (5mg / 2mg, 1.0 ml Draw) containing bottles. The values obtained from the immediately processed plain tubes were taken as the baseline glucose concentrations. Blood samples preserved with NaF and citric acid were stored at room temperature and analysed after 1 hour and 2 hours of collection and the values obtained were compared against control value from the plain tube. Statistical Package for Social Sciences (SPSS 15.0) was used to analyze data. Results obtained were compared using paired two tailed Student's t-test. Significance was accepted at < 0.05 in all cases.

Results showed that there was a significant reduction in the mean glucose concentration in comparison to the baseline glucose concentration [8.9 mg/dL or 8.8% at 1 hr and 12.2 mg/dL or 11.9% at 2 hr; p < 0.05] when blood was drawn into tubes containing NaF/K₂C₂O₄. In contrast, the reduction in the mean glucose concentration was comparatively less [2.3 mg/dL or 2.2% at 1 hr and 4.4 mg/dL or 4.1% at 2 hr] when blood was drawn into tubes containing citric acid/EDTA-2Na.

Based on the findings of this study, the citric acid containing tubes are statistically superior to the NaF containing tubes in the *in vitro* preservation of blood glucose. Treating blood samples with citric acid (Acidifying blood samples) minimizes the loss of glucose *in vitro* and thereby minimizes the risk of missing cases with glucose concentrations near the upper limit of the normal reference range. Therefore, citric acid would be a simple and more reliable alternative for the use of NaF in the *in vitro* preservation of blood glucose.

ABSENT FOOT PULSES AMONG A GROUP OF MEDICAL STUDENTS WHO DO NOT HAVE A HISTORY SUGGESTIVE OF PERIPHERAL VASCULAR DISEASE

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Examination of foot pulses remains an essential component in the assessment of a patient with peripheral vascular disease (PVD). It has long been considered that absent foot pulses, with a history of intermittent claudication, is highly suggestive of occlusive arterial disease in the lower limb. The presence of anatomical variations in the arterial tree can lead to absent foot pulses in classically defined areas, which can interfere with making a correct clinical diagnosis. The objective of the study was to describe the percentages of those with absent foot pulses, among a group of medical students.

A group of 150 medical students aged between 20 to 25 years, without a history suggestive of PVD was selected for the study. The Dorsalis Pedis and the Posterior Tibial pulses were palpated according to the standard technique described in Hamilton and Bailey. The students who lacked the palpable pulses were further examined using a hand held Doppler device.

Out of 150 participants 103 were females. Of the participants, 12 (8%) had an impalpable Dorsalis Pedis pulse, of whom 9 were males and 3 were females. It was absent on the right side in 8 and on the left side in 4 participants. It was absent bilaterally in 2 of the participants. All the participants with impalpable Dorsalis Pedis pulse had a detectable pulse upon Doppler examination. Of the 150 participants, 11 (7.3%) had an impalpable Posterior Tibial pulse, of whom 8 were males and 3 were females. It was absent on the right side in 4 and on the left side in 7 participants. It was absent bilaterally in 2 participants. All the participants with impalpable Posterior Tibial pulse had a detectable pulse upon Doppler examination.

The percentage of impalpable Dorsalis Pedis pulse in the present study (8%) was comparable with the percentage described in Hamilton and Bailey (10%). A similar study conducted in the United Kingdom described it to be 3.1%, which is considerably lower than the findings of the present study. The fact that all the subjects with impalpable Dorsalis Pedis pulse had a detectable pulse upon Doppler examination indicates the unreliability of digital palpation alone. Similarly in the present study the Posterior Tibial pulse was impalpable in 7.3%. In contrast, the aforementioned study conducted in the UK reported a palpable Posterior Tibial pulse in all the subjects (224); according to the Hamilton and Bailey, palpation of the Posterior Tibial pulse is often difficult and absolute reliance cannot be placed upon the absence of its pulsation. It is apparent that there is a place for further studies in this area, including cross sectional studies using detailed imaging modalities and cadaveric dissections to describe anatomical variations.

Based on the results of the present study it is apparent that digital palpation of foot pulses alone is not reliable enough to ascertain their absence. The combination of hand held Doppler device and digital palpation may increase the negative predictive value.

ADVERSE EFFECTS IN ELDERLY MULTIPLE MYELOMA TREATED WITH NOVEL ANTI-MYELOMA AGENTS

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The global elderly population is expected to be doubled in the next two decades and the incidence of geriatric myeloma patients is expected to be increased (1). Treating with novel anti-*myeloma* agents has made a remarkable improvement in the outcome *myeloma* patients (2). Difference in drug metabolism with age, presence of co morbidities and interactions with other concurrent medications, may be the aetiologies behind the increasingly seen adverse effects in the elderly group of patients with myeloma. The goal of therapy in *myeloma* should be to control the disease and increase progression free survival (PFS) and overall survival (OS) while attaining the maximum quality of life (QOL). The objective of the study was to analyze the adverse events experienced in newly diagnosed *multiple myeloma* patients >70 years who were treated with novel anti *myeloma* therapy.

This was a retrospective study of newly diagnosed symptomatic *multiple myeloma* patients (≥70 years of age) who presented to the Haematology department at Princess Royal University Hospital, Orpington, United Kingdom from 1st of January 2006 to 31st of August 2013. Total number of patients eligible was 34 out of 45 patients. The types of chemotherapy given and the adverse effects experienced during first 4-6 cycles of chemotherapy were retrieved from clinic records.

The types of regimens given with their frequencies were, CTD (*Cyclophosphamide, Thalidomide, Dexamethasone*) 12%, attenuated CTD 38%, MPT (*Melphalan, Prednisolone, Thalidomide*)27%,MP(*Melphalan,,prednisolone*)17%,VCD(*Velcade,cyclophosphamide,Dexamethasone*)3% and *Dexamethasone*3%. Adverse effects were graded as per WHO chemotherapy toxicity grading. 29 patients out of 34 experienced adverse effects such as neuropathy 19%, constipation 15%, *cytopenias* 12%, skin rash 10%, , infection 8%, fatigue 8%, nausea6%, DVT 6%, oedema2%, loss of weight 2% and arrhythmia 2%

The current practice is to select the regimen of chemotherapy by prior assessment of renal functions, *cytopenias*, thrombosis risk, neuropathy and patients' preference. Dose reductions are done in the presence of renal failure or neuropathy. However, this study showed, during the course of chemotherapy many patients suffered from adverse effects leading to unpleasant symptoms and leaving some permanent disabilities or refusal to complete expected number of chemotherapy cycles. Therefore, this emphasizes the need of developing a grading system for dose reduction at the start of chemotherapy in elderly *myeloma* patients, taking into consideration factors such as age, performance, co morbidity (assessed by using a score to detect all vital systems of the body) and the concurrent medication.

FORMULATION AND STABILITY EVALUATION OF VIRGIN COCONUT OIL BASED (VCO) 5% OILY PHENOL SOLUTION FOR SCLEROTHERAPY

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Chronic hemorrhoids are a common clinical condition and sclerotherapy is one of the modes of treatment. Phenol is injected into the sub mucosa of hemorrhoids during sclerotherapy. In hospitals oily phenol injections are prepared extemporaneously by dissolving solid phenol into a suitable fixed oil. Olive oil and Almond oil are commonly used for this purpose. In Sri Lanka Virgin Coconut Oil (VCO) is widely available and is much cheaper than Olive and Almond oil. Utilizing VCO to prepare oily phenol solutions can be a good option to reduce the cost. Thus the aim of the study was to formulate VCO based oily phenol solution and compare its properties with almond and olive oils.

The method to prepare oily phenol injections was adopted from British Pharmacopeia (BP), 2012, volume III. Three different oils namely; olive oil, almond oil and VCO were used to formulate 5% oily phenol injection. Their characterization and stability were analyzed at room temperature to check the suitability of VCO for oily phenol injection. The characterization was evaluated by performing the assay test. Density of prepared solutions was also studied. Assay tests were conducted in triplicates.

All samples remained stable for 60 days under visual observation without any phase separation, creaming or sedimentation at room temperature. Density tests and stability evaluation results were similar for three different oily phenol solutions at room temperature. However, there was a difference in the results produced by the assay test. Mean values of assay test for almond oil, olive oil and VCO were 4.78%, 4.71% and 4.38% w/v respectively. According to BP 2012, the specified range for assay test for these oils should be in the range of 4.75%-5.25% w/v. Phenol content in VCO based oily injection was less compared to other two oils. Since this study was conducted under room temperature and humidity conditions, the researchers of this project believe further evaluation should be carried out to control the evaporation of phenol in VCO based injection. To minimize the evaporation of phenol in VCO it is recommended that room temperature and humidity should be controlled.

In conclusion, all three oily phenol solutions showed somewhat lesser amount of phenol percentage and there were no obvious difference in the phenol content of these three samples. Also the study proved that the VCO based oily phenol solution was stable and future studies should focus on improving the phenol content in VCO based oily phenol solution.

ORAL HEALTH STATUS AND OWN PERCEPTION OF ORAL HEALTH AMONG INSTITUTIONALIZED CHILDREN IN CENTRAL PROVINCE, SRI LANKA

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Institutionalization is the placement of individuals in institutions, such as orphanages. Young children in institutional care have often been abandoned at birth or soon after. Studies revealed that children from disadvantaged backgrounds have shown a high prevalence of dental caries and significantly low utilization of dental care. This is an under-researched area in both local and global level regarding the oral health status and dental epidemiological investigations of the socially marginalized groups. Such studies are important to expand the level of oral health care delivery system. Aim of this survey was to determine “the oral health status and their perception of oral health among institutionalized children under care of Department of Probation, Central Province, Sri Lanka”. A cross sectional population based study was conducted at all 36 homes of institutionalized children in the province. All the children (1104 children) were screened and children above 6 years were included to the study. An interview administered questionnaire was filled for each child. Data such as age, educational status, patterns of oral hygiene practices, dietary habits and history of professional dental care were recorded. Comprehensive oral examination was conducted by three calibrated examiners for each child. Every child who had found with necessity of treatment had been treated on site or referred to special care. Out of 685 participants who have fulfilled the inclusion criteria, 54.01% were females and 45.99% were males. Mean age of study subjects was 11.88±4.02. Age of 66 children could not be accurately confirmed as they did not have birth certificates and their age was estimated using the dental age. The prevalence of dental caries in deciduous teeth was 26.81%. When the permanent teeth were considered, a percentage of 56.38% was noted. The mean dmft value was 0.74±1.60 while the mean DMFT value was 1.18±1.42. Untreated caries was dominant in both dentitions. In males the dmft value was 0.87±1.77 and DMFT value was 1.10±1.35, whereas in females the dmft value was 0.63±1.43 and DMFT value was 1.24±1.47. A higher value of caries indices was seen in the 13-17 age group. Gingival bleeding presented in 44.35% in study subjects. Majority (68.47%) stated that they brush their teeth twice a day. Fluoridated toothpastes usage was seen in 44.09% and 52% of them were not aware of whether the toothpaste contains fluoride or not. The quality of life statements and dental caries indices (dmft /DMFT) were analyzed using one way Anova test and there was a significant association of DMFT with missing classes or school days due to dental pain. Difficulty in biting hard foods was significantly associated with these indices. According to the published National Oral Health Surveys so far in Sri Lanka, prevalence of dental caries of these age groups was much higher than the presenting study. Despite higher usage of tooth brush and tooth paste, high percentage of bleeding gums were found, which could be attributable to improper tooth brushing techniques and lack of individual supervision. Care takers and administrators of these institutions have to play an important role by providing a health promoting environment and healthy lifestyles.

GENERAL HEALTH CONDITION OF SELECTED ELDERLY IN A SEMI URBAN POPULATION IN THE KANDY DISTRICT

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The proportion of the world's elderly will double from 11% to 22% from 2000 to 2050. Similarly in only 23 years, the elderly population in Sri Lanka will double from 7% to 14%. With that, issues related to mental health and non-communicable diseases in the elderly will also increase.

Our cross sectional study was conducted in the geriatric clinic at Kadugannawa Base Hospital in the Yatinuwara Divisional Secretariat area. The study population consisted of 287 Sinhala speaking, randomly selected patients who were attending the clinic. Data was collected using a pre designed semi structured questionnaire which examined the patient's economical, social background and health statuses. Data analysis, mainly medico-social profile, their needs, mental statuses and causes for depression was analyzed using SPSS 20.0

The mean age of the study population was 69.36 years (sd ± 6.446, IR= 10) and 81 (28.2%) were male patients and 206 (71.8%) were females. Of the patients, 78 (27.2%) were found to have depression and there was no significant gender difference (female: male=29.6%: 21%, p=0.335). The main reasons for depression were loss of spouse, living without children and conflicts between children and in-laws. 13 (4.5%) patients were living alone, mostly due to loss of spouse. Among those 9 (7.8%) patients were in the 70-79 age group and 4 (2.7%) belonged to the 60-69 age group. 12 (5.8%) of female patients and 1 (1.2%) male patient were living alone. 6 (2.5%) patients who were found to have impaired mini cognitive assessment were living alone.

Degenerative bone diseases (DBD), diabetes, lung diseases and ischemic heart diseases were more prevalent in this group. 52 (18.2%) of the entire sample had DBD, of whom 42 (20.5%) were females, and there was no significant gender difference (p value=0.108). 44 (15.4%) patients were suffering from lung diseases, mostly chronic obstructive lung diseases, of whom 28 (13.7%) patients were females and 16 (19.8%) were males. All the females were non-smokers. 11 (3.8%), 23(8%), 5 (1.7%) of males were ex-smokers, occasional smokers and dependent smokers respectively. Though there was a significant gender difference in smoking (p=0), lung disease did not show any significant difference among gender (p=0.198)

In conclusion, the elderly population is more prone to get social isolation and debilitating non communicable diseases. As they face risks of further deterioration of their current mental and physical status in future, introduction or expansion of social welfare and care services targeted to this most vulnerable people is essential. Through such approaches, the country can reduce the demand for expensive institutional care, reduce the burden on caregivers and enable elderly people to continue to live in their home/community.

***IN-VIVO* ANTIOXIDANT ACTIVITY OF RASNA SAPTHAKAYA DECOCTION IN WISTAR RATS**

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Rasna sapthakaya (RS) decoction is a mixture of seven Ayurvedic herbs and is used to treat chronic inflammatory joint diseases. The RS decoction is widely used in Sri Lanka and India. Reactive oxygen species induce lipid peroxidative tissue damage which has been implicated in the pathogenesis of various diseases. Lipid peroxidation is assessed indirectly by the measurement of the secondary products, such as malondialdehyde (MDA). The present study, evaluated the *in-vivo* anti-oxidant activity of RS decoction by Thiobarbituric acid reactive species (TBARS) assay in the rats. For this study, healthy, two months old Wistar male rats were randomly selected. The rats were divided into two groups named as test and control (n=6 in each). The test rats were orally administered with freshly prepared RS decoction (40 mg/kg) for 28 consecutive days and the control group received distilled water. Blood samples were collected at Day 0 and Day 29 from the study rats to evaluate the serum malondialdehyde (MDA) level by TBARS assay.

On the 29th day, the serum MDA level of the control and test group were 4.71 ± 0.07 $\mu\text{mol/l}$ and 1.09 ± 0.04 $\mu\text{mol/l}$ ($p < 0.002$) respectively and showed a statistically significant reduction of serum MDA concentration from the Day 0 value of the test group. The percentage anti-oxidant index (AI %) was 78.1 %.

Thus we provide evidence that RS decoction exerts statistically significant effects by inhibiting the malondialdehyde formation *in-vivo*. It can be concluded that the *Rasna sapthakaya* decoction possess potent anti-oxidant properties which is demonstrated in this animal study.

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DISTRIBUTION OF DYSLIPIDAEMIA AND ITS ASSOCIATES IN A RURAL COMMUNITY IN THE KANDY DISTRICT

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Cardiovascular diseases (CVD) are the number one cause of death globally. An estimated 17.5 million people died from CVDs in 2012, representing 31% of all global deaths. Dyslipidaemia is a major modifiable risk factor for the development of CVDs. Thus, the present study was conducted to assess the prevalence of dyslipidaemia in a selected rural community in the Kandy district.

This descriptive study was conducted on a selected random sample of participants from an on-going non-communicable diseases (NCDs) prevention programme implemented in the Yatinuwara divisional secretariat area. Socio-demographic characteristics, anthropometric measurements and lipid profiles of the study subjects were collected for analysis.

Of the 359 study subjects, 259 (72.1%) were patients with dyslipidaemia. 58% had normal values of total cholesterol (TC) (<200 mg/dl), 27.1% had borderline (200-240 mg/dl) and 14.9% had high levels of TC (>240 mg/dl). 50.3% of subjects had risk levels (<55 mg/dl) of HDL values and 49.7% had normal HDL values (>55 mg/dl). 73.8% had normal values of LDL (\leq 130 mg/dl) and 26.2% had more than >130 mg/dl. 53.2% had normal levels (<3.5) of TC to HDL ratio and 46.8% had risk values (\geq 3.5). Dyslipidaemia was not associated with age ($p=0.26$) and sex (0.35) of the person or their physical activity levels. A significantly higher mean Body Mass Index (BMI) was seen among people with TC/HDL ratios of more than 3.5 ($p = 0.04$). High TC (>200 mg/dl) was significantly associated with high systolic blood pressure (SBP) but not with diastolic blood pressure (DBP). A high proportion (32.2%) of those with obesity according to waist to hip ratio, had LDL values of more than 130 mg/dl. The corresponding proportion among the non-obese was 15%. This difference was statistically significant.

The proportion of people with dyslipidaemia was 72%. High TC, low HDL levels and high TC/HDL ratios were the main contributors of dyslipidaemia.

COMPARISON BETWEEN 2% TOPICAL PHENYTOIN SODIUM SOLUTION AND SYNTHETIC COLLAGEN IN HEALING OF CHRONIC WOUNDS OF VARIOUS AETIOLOGIES: A PILOT STUDY

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Chronic wounds are a common problem in the community. It may be venous, arterial, diabetic or neuropathic in origin. There is no standard way of treating them. As Sri Lanka is a resource poor country, the aim of this pilot study is to find out an effective and cost efficient way of treating chronic ulcers of various aetiologies.

All the patients, who attended the skin clinic at Faculty of Medicine, University of Peradeniya and who had ulcers of more than 6 weeks duration were included in the study. Informed written consent was obtained from all patients. The patients were randomly allocated to a 2% phenytoin sodium solution treatment group and a synthetic collagen treatment group. All the patients were dressed and evaluated weekly for 4 weeks. Their demographic data and photographic documentation were done. The reduction of the size of the ulcer, presence of granulation tissue and evidence of adverse effects were noted. During the period of this study, if patients were subjected to any other treatment such as antibiotics, it was noted.

A total number of nine patients were included in the study. Of them five patients were in the phenytoin sodium treatment group, of which four had venous ulcers and one had lymphoedema. Their percentage reduction of ulcer size ranged from 25-75%. In the synthetic collagen group there were four patients, of which three had venous ulcers and one had a neuropathic ulcer. Their percentage reduction of ulcer size ranged from 25-90%. All patients developed healthy granulation tissue with reduction of the depth of the ulcer. None of the patients developed side effects or secondary bacterial infections due to either treatment. There was no need to give antibiotics.

Both treatments seem to be effective in treating chronic ulcers of various aetiologies. However in our clinical setting, phenytoin sodium solution is a cheap alternative to expensive wound dressing. This study is limited by the small number of patients, and the short duration of follow-up of patients. Hence, we hope to continue the same study with a larger number of patients for a longer duration of time.

SUCCESSFUL MANAGEMENT OF LOWER LIMB LYMPHOEDEMA IN AN OUTPATIENT CLINIC: A PILOT STUDY

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Chronic lymphoedema is a neglected problem. There is no standard way of treating them. Patients are adversely affected socially, economically and psychologically. In advanced lymphedema, there may be presence of skin changes such as discoloration, hyperplasia and hyperkeratosis.

As Sri Lanka is a resource poor country, the aim of this pilot study is to assess the effectiveness of three-layer compression bandaging in the treatment of chronic lymphoedema as a cost effective way of management.

Patients with chronic lower limb lymphoedema were recruited from the skin clinic at the Faculty of Medicine, University of Peradeniya. All the patients had moderate level lymphoedema. There was 1 male patient and 3 female patients aged between 30 years to 60 years. Three circumferential limb measurements were taken from above the ankle, mid calf and below the knee with the medial malleolus as the fixed starting point. All the patients were dressed with three-layer compression bandaging weekly. The three layers consisted of surgical cotton, gauze bandages and crape bandages. Their maximum circumferential limb reduction (MCLR) was measured at 3 places. During the treatment of 6 weeks, 4 patients with lymphoedema were recruited and patient 1 showed MCLR of 5%, 2.5% and – 5.1% at above the ankle, mid calf and below the knee respectively. Patient 2 showed MCLR of 18.6%, 6.9% and 1.3% at above the ankle, mid calf and below the knee respectively. Patient 3 showed MCLR of 3.5%, 2.7% and 1.3% at above the ankle, mid calf and below the knee respectively. Patient 4 showed MCLR of 6%, 5.1% and 2.4% at above the ankle, mid calf and below the knee respectively. None of the patients complained of discomfort or any adverse reactions.

Data from this study indicate that 3-layer compression bandaging is a safe, effective and economical way of treating patients with lymphoedema in an outpatient setting. However it needs training and a dedicated staff. Further studies are needed with bigger samples to confirm these findings.

KNOWLEDGE AND PRACTICES ON FOLLOW UP CARE AMONG KIDNEY TRANSPLANT RECIPIENTS OF A SELECTED NEPHROLOGY UNIT

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Chronic kidney disease is a universal problem. In end stage renal disease, patients require renal replacement therapy which includes renal transplant. Following transplantation, patients require strict adherence to life style changes to ensure optimum outcomes. Follow up care after transplantation prevent rejection and increase survival. The current study focuses on assessing knowledge and practices on follow up care of kidney transplant recipients of National Hospital Sri Lanka. (NHSL)

A descriptive cross sectional study was conducted and data was obtained from patients who were followed up at the selected nephrology clinic. An interviewer administered questionnaire was used for data collection. Data were analyzed using SPSS –20 educational statistical package. Chi-square was used to determine the association of perceived knowledge and practices with demographic variables. Paired *t*-test was used to compare mean pre- and post-test scores on the questionnaire and assess the correlations of knowledge and practices with sex, age and level of education of the patients of renal replacement therapy.

There were 152 subjects in the sample. They were between 16-75 years of age (44.7, SD: ± 13.25) and 67.1% of these were males. Majority (48.7%) of participants were aged between 46-60 years. Hypertension (35.5%) was the main cause for chronic renal disease while 25% were idiopathic. Majority (77.6%) had a good knowledge on taking immunosuppressive drugs. Awareness about foods to eat was not optimal with only 58.6% being aware that a low salt diet is indicated. Most (70.4%) did not engage in any exercise related activities, a good knowledge regarding signs of urinary infections was seen in 52.6% while 59.2% knew that severe pain at the transplant site was a sign of rejection. Masks were used by only 43.4% of participants. Level of education was associated with a good knowledge of drugs ($p < 0.05/0.000$), and practices of infection control was associated with level of education ($p < 0.05/0.043$) while sex was associated with practices of infection control ($p < 0.05/0.016$). Knowledge of infection control was at a satisfactory level (52.6%) though practices of infection control was less (29.6%). Knowledge on drugs seemed to be good. The knowledge and practices of transplant recipients on infection control and life style changes that need to be instituted should be improved as this could lead to better outcomes following renal transplant.

ANALYSIS OF THE SIGNIFICANCE OF PATTERN OF INVASION IN RELATION TO PROGNOSIS OF ORAL SQUAMOUS CELL CARCINOMA

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Oral squamous cell carcinoma (OSCC) is the commonest cancer in men in Sri Lanka. Many oral cancer patients especially in South Asia seek treatment at the advanced stages of disease with subsequent poor prognosis. The most important prognostic factor in OSCC is the presence of neck lymph node metastases at diagnosis, which can decrease the 5-year survival rates to lower than 50%. However, treatment of the clinically negative neck in patients with early-stage oral carcinoma is still controversial. Invasive front or the tumour-host interface of the cancer is known to be important in predicting metastasis & prognosis. Pattern of invasion, is a histological marker, where the arrangement of tumour cells at the advancing front can be graded as large cohesive tumour islands (pattern I), small islands (pattern II), thin strands (pattern III) and individual tumour cells (pattern IV). Further it has been demonstrated that the use of molecular markers together with the traditional histological methods, may improve the strategy for comprehensive management of patients with OSCC. The main objectives of the present study were to evaluate the relationship between pattern of invasion and metastasis and to find out whether there is any correlation with age and gender. This may help in planning treatment which may reduce the morbidity and cost of the advanced procedures.

In this study, a total of 345 histologically confirmed OSCC cases treated with excision of the lesion and neck dissection at Oral and Maxillofacial units of Sri Lanka (181 negative, 164 positive) have been assessed for their invasion pattern and the demographic data on age and gender. All these data has been obtained from the Oral Pathology database and the histological materials collected from the archives of the Department of Oral Pathology. The most representative section from the main tumour was selected to analyse the pattern of invasion. Nodes from each level which have been harvested from the neck dissection have been assessed for metastasis. This data has been analysed to obtain important correlations.

Age categories did not show a statistically significant association with pattern of invasion. When considering the gender of the study groups, females were mostly present with invasion pattern IV (43.2%) and males with invasion pattern III (37.3%). Regarding metastases, more than 50% of cases were negative in both genders (males 52.1% and females 53.4%). There was a significant positive correlation between pattern of invasion and metastasis ($p > 0.05$).

Age and metastasis showed a positive correlation whilst a negative correlation was found with pattern of invasion. More importantly a positive relationship was found between the pattern of invasion and metastasis of OSCC.

As this is a preliminary study, in future we would evaluate the relationship between invasive pattern and several molecular markers (Periostin, MMP-9, EGFR, VEGF-C, HIF-1 α , β catenin) by immunohistochemistry and these molecules might be used as molecules in predicting prognosis and metastasis of OSCC.

EFFECTS OF ACUTE HIGH GLUCOSE AND OSMOLALITY ON CHANGES OF INTRACELLULAR CALCIUM LEVEL IN MOUSE NEOCORTICAL SLICES

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Acute high glucose levels and osmotic disturbances lead to profound neurological problems. Only a few experiments have been conducted at cellular level to assess whether neurophysiological changes are induced by altered high glucose and changes in osmolality. The present study was aimed to determine the effects of acute high glucose and high osmolality on intracellular free calcium of neocortex by using a newly developed optical imaging method.

Intracellular free calcium changes were measured in 5 – 10 minutes intervals in layers II-III of neocortex, using two different glucose concentrations and similar osmolality induced by mannitol. Fluorescent emissions by Ca²⁺-Rhod-2 complexes were studied under 5 mM and 10 mM glucose Krebs (controls) with 20 mM and 30 mM glucose Krebs (tests) respectively, to assess the effectiveness of acute high glucose. Further, 5 mM glucose Krebs (control) and 5 mM glucose + 15 mM mannitol Krebs (test) were applied to evaluate the osmotic effect caused by 20 mM glucose.

Thirty millimolar glucose did not significantly affect on intracellular free calcium changes in layers II-III of neocortex, but tendency to an evoked response was shown compared to control. In contrast, 20 mM glucose did not affect on both intracellular free calcium and magnitude of response. However, the response of neocortical slices under high mannitol concentration was significantly reduced ($P < 0.015$). According to these facts the elevation of intracellular free calcium induced by signal transmission is suppressed under the high osmotic condition caused by mannitol while similar osmolality caused by acute high glucose does not significantly change the response. These findings suggest that, the suppression of intracellular free calcium caused by osmotic effects may be compensated by glucose itself or it may reduced by the activity of mannitol. Further experiments are required to elucidate the mechanism of intracellular free calcium regulation by acute high glucose level and mannitol.

BURN INJURY AND ASSOCIATED EFFECTS ON UPPER LIMB MOBILITY, FUNCTIONS OF HANDS AND ACTIVITIES OF DAILY LIVING

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Burn injury causes destruction of skin and underlying tissue. Severe burn is a medical emergency. All over the world burn injuries are common and 80% of burns occur at home. Sri Lanka has higher contribution for hospital admissions due to self-harm burns and post burn complications are severe. It affects on the mobility of major joints of limbs which may restrict and affects day to day activities. Objective of this study was to determine the effect of burn injury on the Active Range of Motion (AROM) of upper limb/s, hand functions and Activities of Daily Living (ADL) who attended the physical therapy department in the burns clinic National Hospital Sri Lanka (NHSL).

Descriptive cross sectional study carried out at out-patient physical therapy department of burns unit of NHSL. Fifty subjects, over 16 years were recruited into the study. Interviewer assisted self administered DASH (Disabilities of Arm, Shoulder and Hand) questionnaire, AROM of upper limb major joints and Signals of Functional Impairment (SOFI) hand function assessment scale were used to collect data.

Flame burns were the most common burn type and majority of the victims were females. Over 75% had affected both upper limbs whereas wrist was the commonly affected joint. Although study population had affected AROM in almost all the joints, numbers of severe contractures were few. Over 75% had reported mild contractures indicating less disability. Response rate for DASH (part I) was about 60% for the study population. DASH (part I) had shown significant relationship with supination, and pronation of right elbow, significance at 0.049 and 0.060 respectively, whereas 0.031 for extension for right wrist. Quite significant affection on "finger flexion" and "opposition" showed on right hand SOFI score. "Open a jar", "writing", "use a knife to cut food etc; showed significance at 0.001 with right hand SOFI score. It revealed burn injury on hands have significant impact on ADLs.

DASH total score and number of subjects to each contracture type showed poor relationship. This indicated that study population does not show considerable disabling contractures which can be affects to the ADLs as a whole. SOFI score for right hand showed significant relationship with selected ADL's. It revealed that AROM limitations of hands restrict functional independence of a person. Involvement of dominant hand maximizes it further. Based on the results it is emphasized that burn survivors need intensive medical care and life long physiotherapy rehabilitation programme.

A DESCRIPTIVE STUDY OF DISTRIBUTION OF ULTRASONOGRAPHIC ABNORMALITIES OF THE THYROID GLAND IN A STUDY COHORT IN THE KANDY DISTRICT

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Thyroid diseases affect a considerable proportion of the population. The prevalence of thyroid abnormalities in patients attending the medical and surgical clinics in Sri Lanka indicates that thyroid diseases are increasing in Sri Lanka. According to the world and local literature, thyroid disease in females is much commoner than in males. High-resolution ultrasonography is a valuable diagnostic tool in the assessment of thyroid diseases. Our study describes the distribution of thyroid abnormalities on ultrasonography in a cohort of people in the Kandy district.

This is a cross sectional community based study, which included 222 randomly selected subjects between the ages of 20-80 years, in the Yatinuwara AGA division of the Kandy district. In our study 69.3% of subjects were found to have thyroid abnormalities. The most common abnormalities were thyroiditis and multinodular goiter (MNG) of the thyroid gland, which amounted to 25.2% and 25.2% respectively. A normal thyroid gland was seen only in 30.7% of subjects. Diffused enlargement of thyroid gland, solitary nodular goiter, combination of MNG and thyroiditis was seen in 14.7%, 8.7%, and 5.5% of participants respectively. Of the study sample 69.1% of females and 30.3% of males had thyroid abnormalities. These findings illustrate that thyroid abnormalities are prevalent among the people of the Yatinuwara AGA division in the Kandy district. Further studies are needed to assess the reasons for the prevalence of thyroid diseases in our study population.

EVALUATION OF PRO-BIOTIC ATTRIBUTES OF HUMAN *CANDIDA* SPECIES: A PRELIMINARY STUDY INVOLVING ACTIVITY AGAINST ENTERIC PATHOGENS

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Probiotics are live microorganisms that provide a myriad of health benefits. Many strains of probiotic bacteria have been isolated from different sources, however only a little work has been carried out on isolation of probiotic isolates of *Candida* species, especially from human origin sources.

Antimicrobial activity is one of the important parameter tested in evaluation of potentially probiotic microorganisms. This study was carried out to evaluate the antimicrobial activity of *Candida* species (*Candida rugosa*, *Candida sake*, *Candida glabrata*, *Candida guilliermondii*, *Candida parapsilosis*, *Pichia ohmeri*) isolated from healthy human's oral cavity against five entero pathogens *Escherichia coli*, *Salmonella typhi*, *Salmonella typhimurium*, *Shigella flexneri*, *Salmonella enteritidis*.

Evaluation of the antimicrobial activity of isolated fungi on indicator microorganism was carried by agar well diffusion assay. *Candida* suspension of Six MacFarland was prepared by using an overnight culture and 100 µl of this suspension was added to the wells. Antimicrobial activity was defined as the diameter (mm) of the clear inhibitory zone form around the well. Selected pathogens were grown on blood agar medium overnight and solution prepared using physiological medium equivalent to Mac Farland standard 0.5 spread on Mueller Hinton agar medium used to assess the antimicrobial activity. The non-inoculated physiological medium was used as control. All assays were carried out twice in replicate. Following incubation at 37°C for 24 hours, the diameter of the inhibition zone around the well was measured.

C. rugosa was shown antimicrobial activity against *S. typhi*, *E.coli* and *S. enteritidis* However, antimicrobial activity remains after 24 hours only for *S. typhi*. For other two microorganisms antimicrobial activity was disappeared within 24 hours and over growth occurred. *C. sake* was shown antimicrobial activity for *E. coli* less than 24 hours and for *S. typhi* remains for 24 hours. *C. glabrata* was not shown any antimicrobial activity against above pathogenic microorganisms. *C. guilliermondii* was shown antimicrobial activity against *S. typhi* *E.coli* and *S. enteritidis*, but antimicrobial activity remains after 24 hours only for *S. typhi*. For other two microorganisms antimicrobial activity was disappeared within 24 hours and over growth occurred. *C. parapsilosis* was shown antimicrobial activity against *S. typhimurium* and *S. enteritidis* but the activity was disappeared within 24 hours. *Pichia ohmeri* was shown antimicrobial activity against *S. typhi* and *S. enteritidis* and antimicrobial activity against *S. enteritidis* was disappeared within 24 hours. Hence, it can be concluded that some human oral *Candida* isolates could be a possible agent in probiotic preparations.

UNEXPECTED HUMAN ACTIVITY RECOGNITION ON SMARTPHONE USING ACCELEROMETER DATA

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Alerting someone to help the people while they have met an unexpected activity, which is caused by a threat, is a vital and useful task, especially for elders and children. Hence, this research is a study about the development of automatic and unsupervised human activity recognition system to detect the unexpected human activity in real-time in indoors and outdoors, using the Smartphone and embedded accelerometer data. The system will automatically recognise both unexpected events that occur suddenly such as falling, jumping, and sudden running and known human activities such as walking, using accelerometer data recorded in the sequence of human activities. If the recognised activity is unexpected, then it will send an alert message as an SMS to relatives or security personnel with GPS location and the affected person can receive assistance.

The developed system is tested using accelerometer data recorded ourselves for various sequences of activities while carrying the Smartphone in our trouser pockets. It provides promising results in detection of unexpected events and successfully sends an alert message. A Smartphone with the tri-axial accelerometer is used to collect data and the Signal Vector Magnitude of Accelerations (SVM_a) and the recurrence pattern are employed for the development of the event detection system. The occurrence of the unexpected activity was decided based on the activity pattern comparison before and after the non-regular (unexpected) activity found in the middle of the accelerometer signal. The raw data, received from the accelerometer, will be affected by noises that are induced by gravity, electro-magnetic and mechanical forces. Based on the observation of the graphical representation of accelerometer data, the noise associated with the raw data is set to 0.03 m s⁻². In order to separate the normal and non-regular activity a threshold is utilized and is determined by experimentation and was set as $T_H = 28 \text{ m s}^{-2}$. For analyzing the sequence of activity, the collected data were grouped into different categories (composition of activities) such as (1) W-W (walking/ non-regular event/walking), (2) W-R (walking/non-regular event/running) and so on.

Accuracy of the detection using the proposed methodology is ranging from 75-100%. The produced promising results were generated without any high level classification algorithms and only use the phone's hardware for data collection as well as processing where most of the other methods used a dedicated server for data processing. In other words, the developed application can detect the activities in real time without external classifiers, servers and supervision. Further, the accuracy of the proposed system can be compared to the existing system which uses high level classification algorithms for known activity. As a conclusion, the proposed system is able to detect unexpected activity using the Smartphone and send an alert message to others.

ANALYSIS OF RUBBER CLONES ACCORDING TO AGRO-CLIMATIC VARIABILITY OF SRI LANKA

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This study has been carried out to identify the adaptability and stability of rubber clones according to the agro-climatic environments in Sri Lanka. Ten rubber clones, which genetically different to each other, namely RRIC 130, RRISL 201, RRISL 205, RRISL 206, RRISL 210, RRISL 215, RRISL 217, RRISL 218, RRISL 219 and RRISL 220 were evaluated during 2007 at eight different climatic locations: Atala, Baddegama, Ganepalla, Pelmadulla, Muwankanda, Sorana, Palmgardden, and Bible. The secondary data were collected from the Rubber Research and Development Institute at Agalawaththa. Girth measurement of each tree after ten years was measured and used for the analysis. A combined analysis of variance (ANOVA) was carried out for the Girth measurement and it is found that there was an interaction between the type of the clone and the location. The slope of regression of clone on the productivity index along with a ranking for the varieties based on the index, Wricke's ecovalence parameter, W_i^2 , was considered to identify the stability and the adaptability of the clones to locations. The clones with slope (β) = 1 is the most stable, the clones with slope (β) > 1 are highly sensitive to environment changes and are adapted to good environments and the clones with slope (β) < 1 are stable and adapted to poor environments. The Wricke's ecovalence parameter (W_i^2), which is a stability index with lower values implying more stable, is used for ranking varieties. RRIC 130, RRISL 201, RRISL 205, RRISL 206, RRISL 210, RRISL 218 and RRISL 220 are stable and can be adapted to any environment. RRISL 215, RRISL 217 and RRISL 219 are identified as highly stable clones and can be adapted to poor environments.

MARKOV CHAIN MODELS FOR ONE DAY INTERNATIONAL CRICKET MATCHES

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While statistical models have been developed for the results of One Day International (ODI) cricket matches, there has been only a little published work about the Markov Chain (MC) model for the ODI results. By classifying the ODI results as win or not win (lost, ties and no results) Markov chain models were developed for the ODI cricket results for the ten popular cricket playing nations (Sri Lanka, India, Pakistan, Australia, England, South Africa, West Indies, New Zealand, Bangladesh, and Zimbabwe). Using the match data gathered from 1995 to 2014, transition probability matrices are obtained. Moreover steady state probabilities are also obtained. The steady state probability of winning a match will be different for different teams. Australian cricket team has the highest probability followed by India, South Africa and Sri Lanka. The steady state probabilities can be used to rank the cricket teams. Thus, an alternative ranking scheme (based on MC models) is proposed for the existing International Cricket Council (ICC) ODI ranking scheme.

Further analysis is carried out for the Sri Lankan cricket team. The objective is identifying the tough and challenging teams to Sri Lankan cricket team. Separate match results (win, not win) were obtained for the Sri Lankan team against each of the other nine teams. Then, transition probability matrices and steady state probabilities were obtained separately for each of the nine opponents of the Sri Lankan cricket team. Sri Lankan team has a steady state winning probability of more than 0.5 against all the teams except Australia, India and Pakistan. Thus, Australia, India and Pakistan are identified as challenging ODI teams for the Sri Lankan cricket team. It is interesting to note that South Africa is above Sri Lanka in ICC ODI ranking, but, it is not a challenging team to Sri Lanka. Thus, in some situations ICC ODI ranking might mislead the prediction of a match result. The steady state probabilities could be used in predicting match results.

IMPLEMENTING THE CONCEPT OF OVERALL EQUIPMENT EFFECTIVENESS IN A LOSS TIME ANALYSIS SYSTEM

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In any manufacturing plant, many steps are taken in monitoring and reducing wastages. Downtime analysis is a much known famous method of monitoring loss time. However, the direct calculation of plant-wise or equipment-wise idle time does not illustrate the true loss affected to the plant and it is not up to the standard. Major concept 'OEE' measurement is commonly used as a key performance indicator (KPI) in conjunction with 'lean' manufacturing efforts to provide an indicator of success. OEE can be illustrated by the three metrics 'Availability', 'Performance' and 'Quality'.

The effectiveness of the newly suggested analysis system was demonstrated via implementing on 'Ceramic Tile Glazing Process', which is a major step of the tile manufacturing process at Lanka Walltiles, Padukka. After experimenting simultaneously, classical effectiveness was observed as 76.5% while OEE gave 70.7%. New system shows that the loss of plant was not only due to 'Availability' but also due to 'Performance' and 'Quality' factors. It can be concluded that implementing OEE, exposed the effect of additional loss factors and major fault areas. Furthermore, since it is a direct application of *lean* concepts, it improves the standards of the plant. Also, the data acquiring method was modified for increased data range for extra clarity and improved summarizations.

A COPULA BASED METHOD FOR ANALYZING METHOD COMPARISON DATA

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Method comparison study is a topic of considerable interest in health and biomedical related fields. The use of this study is to compare a new method with a standard established method. This study generally consists of two typical steps, namely, modelling the dataset and using the fitted model to analyse method comparison data. If the two methods agree sufficiently well, then they can be used interchangeably. As a usual practice, it is recommended that a mixed effect model is an appropriate method to model method comparison data. The mixed effect model typically deals with two assumptions, namely, constant variance (homoscedasticity) and normality of error terms. However, these assumptions are generally violated in practice. Thus, in this study our main goal is to propose a model with fewer or no assumptions. The key idea behind the proposed method is the use of Copula to deal with heteroscedastic non-replicated method comparison data. Copula is defined as a multivariate probability distribution for describing the dependence structure between variables. This approach starts with modelling each set of measurements through its distribution function and then transforming each set of measurements into a uniform distribution on $[0,1]$. Finally, the distribution function of each assay is coupled by means of a Copula. The proposed methodology is evaluated by applying it on finger and arm systolic blood pressure data. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) values confirmed that the lognormal distribution with parameters $(\ln N (4.84, 0.029), \ln N (4.87, 0.035))$ and Gumbel Copula with parameter 2.42 fit well with the marginal and the bivariate distribution of the dataset, respectively. The Gumbel Copula is one of several copula classes with special properties in defining the bivariate distribution. Further, the Total Deviation Index (TDI) and Concordance Correlation Coefficient (CCC) values are calculated to check the agreement between the two methods. These values imply that there is a better agreement between these two assays of measurements and hence the two methods can be used interchangeably.

ANALYSIS OF MAJOR RISK FACTORS CONTRIBUTING TO SUICIDE USING LOGISTIC REGRESSION METHOD

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Suicide is a serious public health problem around the world. It is recorded that over one million people die by committing suicide worldwide each year, placing serious problems on individuals, families, communities, and public services. As a result it is important to consider the risk factors associated with suicide and increase factors that promote resilience. Hence this study is conducted to determine the main risk factors associated with suicidal behaviour and suicidal ideation. We analysed mortality data from 2010 to 2015 from Kandy and Jaffna police stations. Summary statistics were used to describe each variable separately. Chi squared tests were performed to find the association between important predictor variables. Since the variable 'suicide status' is dichotomous, logistic regression model was used to assess the effect of that variable. Then a neural network model was used to check the validity of the proposed logistic regression model. When we compared the proposed logistic regression model with the neural network model there were no significant differences between both approaches. Two-way ANOVA has been used to confirm the significant interaction between variables. All statistical data analysis was performed using R software. It is observed that there is a significant contribution of age and civil status in people committing suicide. However, there is no gender difference in committing suicide. It is seen that the attempted methods of suiciding differ from males to females. Moreover, it is concluded that demographic factors especially socio economic problems such as unemployment, poverty and homelessness and stress factors such as financial difficulties and troubles with interpersonal relationships contribute more to the completed suicide.

PERFORMANCE ANALYSIS OF FEW MAJOR ALGORITHMS FOR SOLVING PERMUTATION FLOW SHOP SCHEDULING PROBLEMS

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The Permutation Flow Shop Scheduling Problem (PFSSP) is a well-known problem in manufacturing environment. This problem studies assigning a set of n number of jobs, in the same sequence to each m number of machines. Objectives of the PFSSP are finding a sequence for the jobs that minimize the Makespan; that is the overall time to complete the schedule, maximizing lateness of jobs and etc. This problem seems to be simple, but turns out to be an NP-Hard problem for more than two machines. In this paper, we have considered m machine n job PFSSP with an objective of makespan minimization. A large number of algorithms, heuristics and metaheuristics have been proposed to solve the PFSSP, mainly because of the absence of exact methods to solve problems with more than two machines. In this study, Johnson's algorithm, NEH algorithm, CDS algorithm and Palmer's heuristic have been analyzed for makespan and execution time criteria. Taillard's(1993) well known standard benchmark and generated problems by using problems generator proposed by Watson et al. (2002) have been used for the performance analysis. Four separate Java applications are coded to solve any given PFSSP instance with reference to above four selected algorithms. Each Java application gives job sequence, makespan and execution time as outputs. Relative Percent Deviation (RPD) and an Average Relative Percent Deviation (ARPD) are used as performance measures by comparing the solutions of each algorithm to the best known solutions. In the analysis, the problem instances are categorized into instances from Taillard, instance with two machines and instance with more than two machines. According to the results of Taillard benchmarks ARPDs of NEH, Palmer and CDS were 4.01%, 12.86% and 19.62% respectively. Then NEH algorithm performs better than CDS and Palmer's heuristic. But Taillard benchmarks are not sufficient for the analysis, and then moves to the Watson's problems generator. According to the results of two machine instances, ARPDs of CDS and Johnson's algorithms are equal to 0.1827% and ARPDs of NEH and Palmer's heuristic are 0.1837% and 0.9453% respectively. Then we can conclude that CDS and Johnson's algorithms are appropriate for two machine problems. In addition to that, the accuracy of Palmer's heuristic is significantly increased when number of jobs is increases. In the instances with more than two machines, the accuracy of NEH is higher than CDS and the accuracy of CDS is higher than the Palmer's heuristic. Then we can conclude that NEH algorithm is appropriate for more than two machine problems. Furthermore, in the instances with more than two machines, the accuracy of Palmer's heuristic also increases when the number of jobs increases. The execution time of Palmer's heuristic is extremely low, when compared to all other algorithms in each and every situation. Finally, a generalized Java application is developed to solve any given PFSSP by selecting highest effective algorithm according to the performance analysis.

TIME SERIES MODELLING OF MONTHLY MAXIMUM TEMPERATURE IN COLOMBO, SRI LANKA

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One of the most important concerns of present advent is on climate change and it has essential implications for the social, business and economic activity of the country. The monthly temperature data of 100 years (1914-2013) have been collected from Meteorological station, Colombo Sri Lanka. The data were then analyzed to identify the maximum temperature obtained on any month, in during any monsoon season (4 seasons). The objective of this study is to identify the best fit time series model for each period of study in Colombo region. As a consequence the forecast values have been reported in this study based on the identified models. The models employed in this study are exponential smoothing (Holt's and Brown's) and autoregressive integrated moving average (ARIMA) models (Box-Jenkins). Model parameters were estimated by using the maximum likelihood method. Two statistical criteria (AIC and MSE) were carried out in order to select the best ARIMA model on the basis of highest rank with minimum computed value of the accuracy measures. In addition, under the forecasting error, three criteria (RMSE, MAPE, MAE) were used to identify the final forecast model based on the minimum value of the criterions. The ARIMA (2,1,2), ARIMA (2,1,3), ARIMA (0,1,1) and Holt's linear trend model were found as the best forecast model for the north-east, first-inter, south-west and second-inter monsoon season period of study, respectively. The final fitted model has been efficiently used to forecast the maximum temperature for each season. The model revealed that the forecasted maximum temperature will reach on 27.6, 28.5, 29.0 and 27.8°C for the periods respectively in 2016. In similar manner, the relevant forecasts of maximum temperatures are listed against the short term horizon for the four seasons of a year.

A STUDY OF SMOKING CESSATION OF USA ADULTS USING MARKOV CHAIN METHOD

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Modern probability theory studies several processes for which the knowledge of previous outcomes influences predictions for future experiments. When we observe a sequence of chance experiments, all of the past outcomes could influence our predictions for the next experiment. Russian mathematician A.A. Markov (1856-1922) began the study of an important new type of a process. In this process, the outcome of a given experiment can affect the outcome of the next experiment. This type of process is called a Markov chain. Markov chain models are used to describe an experiment or measurement that is performed many times in the same way.

In this work, our aim is to discuss the properties of the Markov Chain model applied to the data set which includes the details on smoking cessation of U.S.A. adults. In this set of data, the selected possible outcomes are, an adult being a non – smoker (A), a smoker who is interested in quitting (B), a smoker who is not interested in quitting (C). All the data was taken from CDC Morbidity and Mortality Weekly reports 2011 and 2009. Using the information given in the data set, the transition probabilities of matrix P were calculated and they are $P_{AA} = 0.951$, $P_{BA} = 0.062$, $P_{CA} = 0$, $P_{AB} = 0$, $P_{BB} = 0.524$, $P_{CB} = 0.879$, $P_{AC} = 0.049$, $P_{BC} = 0.414$, $P_{CC} = 0.121$. Since column entries of matrix P add up to 1 this is a stochastic matrix (a Transition matrix). Then, the initial probability vector for this study was obtained which was named as X_0 and $X_0 = [0.794; 0.0933; 0.1127]$; which explains the probability of each outcome in 2008. Moreover, it shows that the probability of non- smokers in 2008 is 0.794, smokers who are interested in quitting in 2008 is 0.0933 and that of smokers who are not interested in quitting 2008 is 0.1127.

Furthermore, the properties of the transition matrix were analyzed and regularity was determined and the equilibrium approach was calculated. Using this method, smoking behavior of US adults was predicted. Our choice of transition probabilities for each outcome, lead to a regular transition matrix P . Hence, after 92 steps, the system converged to a steady state vector $V = [0.4508; 0.3562; 0.1929]$, which is predicted to be seen after 184 years. Therefore, mandatory actions can be taken to prevent tobacco smoking. All the matrix calculations were implemented by MATLAB software. The proposed method is suitable for any country to analyze smoking behavior among different age groups, gender base, education level, ethnicity etc.

NETWORKS CLUSTERING METHOD BASED ON SELF-ORGANISING FEATURE MAP FOR N-DIMENSIONAL PROJECTION OF NETWORK DATA

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Different methods are available for community detection in networks. Hierarchical clustering, affinity propagation, spectral graph clustering, modularity of networks and edge removal are some popular methods applied for the task. Network topology based clustering methods like spectral graph clustering; network modularity and edge removal are very useful because they can be applied even when no other features are available except the interaction between nodes. However, distance based clustering algorithms cannot be applied directly to network data due to the absence of features to express the similarity/dissimilarity of a node to other nodes.

Aim of this study is to find communities in networks using Self-organizing feature maps (SOFM) for network topologies in N-D space projected using a novel projection algorithm. When only network topology is available network projection provides enough features to cluster using SOFM. The study utilizes a projection model based on its adjacency matrix to extract features that can be projected into N-D feature space. Multiplication of adjacency matrix with its transpose matrix returns a square matrix that can be used to compute its Eigen values and corresponding eigenvectors. Once the Eigen values are arranged in the descending order, corresponding eigenvectors can be used to project the network in N-D space.

SOFM learn to classify input space according the distribution and topology of the input vectors. One of the very important features of SOFM is that the neighbouring neurons in a self-organizing map learn to recognize neighbouring sections of the input space. Furthermore, SOFM can be used for the classification of any n-dimensional arrangement. Function approximation capability of SOFM provides more intelligent and flexible cluster generation of the input data.

To evaluate the model, one computer generated network (bowtie with seven nodes) and a real world network (Zachary's karate club) were used. Results show that the number of nodes, which are clustered correctly, are decreasing when the number of features are increasing. Due to competitive learning algorithm in SOFM, it always assigns nodes to a particular cluster. For the karate club network, clustering accuracy stays at hundred percent until feature space grows to fourth dimension.

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FORECASTING SRI LANKAN GOLD PRICES USING TIME SERIES ANALYSIS

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Over the past few years, the demand for gold has expanded because the use of gold both in the industrial goods and in the jewelry sector. From an economic point of view and financial point of view, the movement of the prices of gold is both interesting and important. It can be measured and planned for the future decisions. The purpose of this research study is to develop two models; Auto Regressive Integrated Moving average (ARIMA) model and Vector Auto Regressive (VAR) model for forecasting monthly gold prices per troy ounce in Sri Lanka.

This study takes monthly data from January 2005 to May 2014, constituting 113 observations. Among those, 90% observations were selected for modeling and 10% observations were used to check the validity of fitted models. For the study, the Mean Absolute Percentage Error (MAPE) was calculated as the forecast accuracy measurement. In time series approach ARIMA (2,1,2) (Auto Regressive Integrated Moving Average) model was selected as the best model to forecast monthly gold prices in Sri Lanka as this model comply with all conditions and assumptions of ARIMA. MAPE value of fitted data from ARIMA (2,1,2) model is 9.8855.

In econometric approach Vector Autoregressive Model (VAR) was fitted for the gold prices in Sri Lanka. Based on the literature & preliminary analysis, monthly data of Exchange rate (Sri Lankan rupees per dollar), inflation rate and narrow money supply (Rupees in million) were selected as the explanatory variables to build the VAR model. The study found that the change in the gold price of current month is affected by 94.03% of the change in the gold price of previous month. Therefore, it can be said that the percentage change of the gold price of previous month is highly affected to the percentage change of the gold price of current month. Percentage change of exchange rate of the previous month, percentage change of inflation rate of the previous month and percentage change of money supply of the previous month are jointly affected to the percentage change of gold price of the current month. MAPE value of fitted data from VAR model is 12.45.

It is concluded that from the two models, ARIMA (2,1,2) and VAR are suitable to forecast the gold prices in Sri Lanka for short time periods. The study conclude that ARIMA (2,1,2) model is a more appropriate model to forecast the gold prices in Sri Lanka than the VAR model.

A MORPHOLOGICAL AND GRADIENT BASED APPROACH TO CLASSIFY PLANT LEAVES USING SUPPORT VECTOR MACHINES

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Plants are an important resource for human well-being. Plant recognition is very essential in agriculture for the management of plant types whereas botanists can use this application for medicinal purposes. Leaves of different plants have different characteristics which can be used to classify them. The key issue in leaf recognition lies in whether the chosen features are constant and have good capability to discriminate various kinds of leaves.

This paper presents a simple and computationally efficient method for plant identification using digital image processing and machine learning techniques. The proposed approach consists of three phases: preprocessing, feature extraction and classification. Preprocessing is the technique of enhancing data images prior to computational processing. The feature extraction phase derives features based on basic geometrical, digital morphological and histogram of oriented gradients (HOG) of a leaf image. The basic feature measures are the leaf diameter, area, perimeter, physiological length and width. The morphological features are smooth factor, aspect ratio, form factor, rectangularity, narrow factor, and perimeter ratio of diameter, perimeter ratio of physiological length and physiological width, and vein features of leaves. These features are then represented as a fixed-length feature vector which is the input to a standard classifier for efficient classification. The testing results were obtained with linear support vector machine (SVM) classifiers performed as multiclass classification. SVMs are generally robust over different training samples as it delivers a unique solution, since the optimality problem is convex. The proposed method is evaluated on *Flavia* dataset that consists of thirty two classes each having 50–77 sample of plant leaves.

The proposed system is trained with few images (i.e., 30 images per class) and tested on a large number of images of the *Flavia* dataset. Moreover, the proposed system involves no manual process in extracting features and classifying them. Testing results show around 90% of classification rate using HOG descriptors combined with basic and morphological features. We also increased our training set and reduced the testing set to be as 10 images per class so that the comparison of the proposed technique becomes same as of others' experimental setup in the literature. In this regard the classification rate is slightly better than others and found to be near 95% with the reduced feature set of basic and morphological features. Our main argument in this work is not just to show an increased performance but to propose the selection of discriminative features that could be applied on the classification of plant leaves.

BLASCHKE–LIKE PRODUCTS OF DEGREE TWO

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Let $\mathbb{D} = \{z \in \mathbb{C} : |z| < 1\}$ and $\partial\mathbb{D} = \{z \in \mathbb{C} : |z| = 1\}$. A finite Blaschke product of degree n is a function of the form $\lambda \prod_{k=1}^n \frac{z-a_k}{1-\bar{a}_k z}$ where $|\lambda| = 1$ and $|a_k| < 1$ for $k = 1, 2, 3, \dots, n$. It is well-known that a finite Blaschke product of degree n is an n -to-one analytical map of the closed unit disk $\overline{\mathbb{D}}$ onto itself and $B(z) \in \partial\mathbb{D}$ if and only if $z \in \partial\mathbb{D}$. A monic Blaschke product of degree 2 which fixes the origin has the form $B(z) = z \left(\frac{z-a}{1-\bar{a}z} \right)$, where $|a| < 1$.

In 2002 Daepf, Gorkin and Mortini proved that for any $\lambda \in \partial\mathbb{D}$, the line joining the pre-images x_1 and x_2 of λ under the B passes through the point a . Conversely, they proved that for any line L through the point a , the points x_1 and x_2 at which L intersects $\partial\mathbb{D}$ has the same image under B . In this study, we investigated similar geometric properties of Blaschke-like products of degree 2 of the form $\hat{B}(z) = z \left(\frac{z-a}{1-\bar{a}z} \right)$, where $|a| > 1$.

First we note that, unlike for finite Blaschke products, $\hat{B}(z) \in \partial\mathbb{D}$ does not imply $z \in \partial\mathbb{D}$. i.e. pre-images of points of the unit circle $\partial\mathbb{D}$ under \hat{B} may not lie on the unit circle. We prove that under \hat{B} , pre-images of $\lambda \in \partial\mathbb{D}$ are on the unit circle if and only if $|\text{Arg } \lambda - 2 \text{Arg } a| \leq 2 \csc^{-1} |a|$. For any λ on this arc, let x_1, x_2 be its pre-images under \hat{B} . If x_1 and x_2 are distinct, then the extended line joining x_1 and x_2 passes through the point a . If x_0 is a multiple root of $\hat{B}(z) = \lambda$ for some $\lambda \in \partial\mathbb{D}$, then the tangent to the circle at x_0 passes through a . Conversely, consider any line L through a which intersects the unit circle $\partial\mathbb{D}$. Then for distinct intersection points x_1 and x_2 , we have $\hat{B}(x_1) = \hat{B}(x_2)$. If L is a tangent line to the unit circle through a and x_0 is a point of tangency on the unit circle, then the equation $\hat{B}(z) = \hat{B}(x_0)$ has no roots different from x_0 . Furthermore, if x_1 and x_2 are two pre-images of some $\lambda \in \partial\mathbb{D}$, which are not on the unit circle under the above mentioned Blaschke-like product \hat{B} , then they lie on the circle $|z - a| = \sqrt{|a|^2 - 1}$ and the extended line joining x_1 and x_2 passes through the origin.

METABOLOMIC ANALYSIS OF HUMAN NON-SMALL CELL LUNG CANCER

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The analysis of genomics, transcriptomics, proteomics and metabolomics data has emerged rapidly over past few decades with the rapid developments of novel technologies in biomedical research. Metabolic analysis is a very recent field compared to other omics data, in which comprehensive analysis of metabolites of a specific system is analysed. It can further be helpful in analysing disease specific biomarkers and enhance the diagnosis clinically. Furthermore, integration of proteomics and metabolomics analysis has already been performed in several omics research programmes: Yizhak et al., Shaw et al., Mujahid et al. and Yu et al. Moreover, it helps providing further insights into real enzyme activity via metabolic regulation.

Non-small cell lung cancer is the most common type of lung cancer, accounting for 85% of all lung cancers. There are two major sub-types: adenocarcinoma (ADC) and squamous cell carcinoma (SCC). Mass spectrometry data retrieved from these two types of non-small cell lung cancers has been analysed by Wen Zhang et al. utilizing a proteomics approach, but analysis of subtypes in metabolomics has not been done earlier. Therefore, we aim to compare proteomics and metabolomics approaches (find whether both are able to distinguish between the two major subtypes and their sub-types), we have performed a new analysis based on metabolomics approach with R XCMS package as well as reanalysed the data with the proteomics approach and observed that it is possible to distinguish between the two basic subtypes with the metabolomics approach as well. We could distinguish between the subtypes by hierarchical clustering exactly as previously achieved with proteomics approach and in metabolomics approach: principle component analysis separated them successfully. Four metabolite biomarkers were identified based on the results and they provide insights into lung/non-small cell lung cancer types. These metabolite concentration could be affected the expression of identified protein markers and that is not studied yet. It will affect the quantification and identification stages of protein biomarker discovery process, which we have developed as an R based software solution.

**ON OBTAINING AN INITIAL SOLUTION TO AN UNBALANCED
TRANSPORTATION PROBLEM: VAM WITH OR WITHOUT
BALANCING**

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Vogel's Approximation Method (VAM) is considered to be a better efficient heuristic compared to the well-known North-West Corner Method (NWCM) and Least Cost method (LCM), since it often gives a minimal or near minimal total cost solution to the transportation problem. Recently, Juman et al. (2013) examined the effect of not processing (and processing) the dummy column on the initial cost solution obtained by the well-known VAM for solving an unbalanced transportation problem (UTP). In this paper, we propose certain conditions to an UTP where a reduced initial cost to this unbalanced transportation problem could be found by the VAM with balanced feature. Hence, it is quite useful in the application of VAM to an UTP.

TESTBED FOR POWER ANALYSIS ATTACK BASED ON THE ARDUINO PROTOTYPING BOARD

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Embedded cryptographic devices such as smart cards are widely used in the present world, where Automated Teller Machines (ATM), Subscriber Identity Modules (SIM) and Security tokens are some famous examples. Power analysis attacks that measure the power consumption of such devices during the cryptographic operation and then do statistical analysis to derive the secret keys have become a significant threat to security. Therefore, researchers are inventing different countermeasures with the goal of preventing such attacks.

Power analysis test-beds are used to evaluate the effectiveness of any proposed countermeasure and also to find vulnerabilities of systems. A test-bed comprises of a cryptographic device, power measurement equipment, measurement automation software and statistical analysis software. Setting up such a test-bed requires the knowledge on a variety of fields such as electronics, computer interfacing, algorithms, programming, and mathematics. In addition, a systematic, step-by-step procedure on building a test-bed is not very well documented in the literature. Thus, a researcher who is new to power analysis has to spend a considerable amount of time on setting up a test-bed. Therefore, we present steps in building such a test-bed that would enable anyone to set up a similar test-bed in no time with equipment that are already available in most laboratories.

The cryptographic device of our test-bed is an Arduino board. Arduino is a popular electronic prototyping board typically based on Atmel microcontrollers. As the Arduino platform is quite simple and user-friendly, it can be easily programmed according to the requirement of the researcher making our test-bed easily customizable. After programming the microcontroller using the Arduino platform to perform encryption, the Atmel microcontroller is detached and fixed on a breadboard with relevant electronic devices and then interfaced with a computer via Universal Serial Bus (USB). The operation of the cryptographic device is such that it receives a plain text from the connected computer, encrypts it and sends the ciphertext back to the computer via USB. A resistor is introduced as the power measurement circuit, and the power measurements are taken into a computer using a digital oscilloscope connected to the circuit appropriately. Few thousands of power traces are obtained while the cryptographic device is performing encryption on different plain text samples, and the process is automated via a Matlab script. Obtained power traces are then analyzed using the Pearson correlation-based statistical approach called Correlation Power Analysis (CPA) on a computer with good computational power. A computer with an NVIDIA Graphics Processing Unit (GPU) is preferred for higher performance. The analysis program returns the secret key of the system.

For breaking the Advanced Encryption Standard (AES) using our test-bed only about 5000 power traces were required to be collected. The measurements took about 2.5 hours, and the analysis took just 3 minutes. While being possible to break a cipher in few hours and with the advantages discussed earlier, our work would make research on power analysis efficient and less complicated.

ENHANCEMENT OF PERFORMANCE IN SINHALA LANGUAGE SYNTAX CHECKING SYSTEM FOR NOVEL SENTENCE PATTERNS BY DEPTH LIMITING

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Natural Language Processing (NLP) approaches for automating Sinhala language is a popular research area. For analyzing the morphology of the parts of speech and building the grammar rules in the grammar parser, programmers refer to Sinhala grammar books containing fixed set of grammar rules. There, it is difficult to collect each and every single rule from one place. Further, as language came to the world first and not the grammar, people with their abstract thinking, manipulate language creatively and in different ways. This causes for derivation of new grammatical patterns into the language. In Sinhala sentences, it could recursively apply the adjectives in sentences such as “කළු කළු කළු බල්ලා මුරයි.” In Sinhala sentence patterns, when verbs act as nouns, adverbs behave as adjectives in them (*ex: “හොඳින් කියවීමෙන් දැනුම ලැබෙයි”*)

In here, such patterns are being combined with existing grammar rules in Sinhala, to manipulate their combination within different sentence patterns. In similar systems, the methods used for parsing grammar rules are not sufficient to define such patterns. To build grammar rules, the system has lexicons for parts of speech, specially nouns, verbs, adverbs, and adjectives. Novelty of this system is, it maintains sub categorization of each part of speech based on the similar features the sub categories perform when generating above patterns. To build the rule engine, Prolog inference engine has been used. When above sentence patterns are fed in to the system, rule engine unifies the sentence to justify its correctness based on the rules defined.

In this system, recursive application of word phrases in sentences leads to infinite looping at the execution stage especially when the given sentences are wrong. That is because; every sentence, which is fed in to the system is taken as a correct sentence by the Prolog inference engine and tries to prove it as a syntactically correct sentence. In this scenario, inference engine tries to unify the sentence with every possible combination of rules to justify its correctness. By infinite looping, execution speed of the system reduces. Therefore in this system; the *meta programming* technique has been used to limit the depth of the sentence to unify it within a certain limit of words. With *meta programming* rule, the sentence is processed within the declared depth limit.

To evaluate the accuracy and the performance of the system, two approaches have been used. These are: testing with depth limiting and without depth limiting. The test cases are randomly selected sentences from grade 3,4,5,6 Sinhala language school books. In this case, the performance of the system by applying depth limit showed 0.36 s of average execution speed and accuracy showed 96% of correctness. As future improvements, rule engine and the size of the lexicons are to be expanded and the performance and the accuracy is expected to be improved by strengthening the rule engine as well.

ADAPTIVE NUMERICAL METHODS FOR FIVE-AXIS CNC MACHINING

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New methods to produce a sculptured surface on a five-axis machine are presented and analyzed. The focus is on the adaptable geometry of the toolpath based on curvilinear grids and space filling curves. The adaptation is performed using a variety of criteria of the tool path quality such as the machining time, tool path length, the kinematic error, scallops, local and global gouging and the continuity. A new promising class of methods designed to construct a curvilinear tool path, which partly or even entirely aligns with the direction of the maximum material removal rate, is introduced. The proposed methodology of the adaptive curvilinear toolpath (ACT) has been tested on a variety of Stereolithography (STL) surfaces including a case study of STL dental parts. Machining crowns/implants for four basic types of the human teeth: molars, premolars, canine and incisors has been considered and analyzed. The reference methods are the standard iso-parametric path, MasterCam and advanced toolpath generation algorithms of UG-NX9 (Unigraphics-Next Generation of Siemens), namely, the Helical/Spiral path and Follow the Periphery path. Our experiments on the milling machines MAHOO-600E and HAAS VF2TR show that there is no universal sequence of steps applicable to every surface. However, a correct choice of the tools available within the proposed ACT-framework always leads to a substantial improvement of the toolpath in terms of its length and the machining time.

A COMPARATIVE ANALYSIS ON ISSUES OF USING DIFFERENT TEST AUTOMATION FRAMEWORKS FOR WEB APPLICATION TESTING

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In today's world web applications are everywhere, from a simple site to a corporate web application. Due to the advantages of web applications such as easy collection of information, speed search of information, communication facilities etc. The growth of web applications has shown a tremendous improvement with the time. So without any doubt the importance of testing a web application has become a crucial process. With the automation of testing using a Test Automation Framework has become a trend since it provides the facility to do testing more efficiently and accurately. The objective of this research is to study about the different Test Automation Frameworks used in the industry and to analyze whether they facilitate the necessity to handle different types of issues and frequent dynamic changes of a web application in a proper manner. A quantitative research approach was used to conduct this research. The target population for this research was 780 QA engineers working at software development companies which are mainly focusing on web application development. The sample size for the study was identified as 120. Primary data collection was carried out with a structured questionnaire distributed to the selected sample and a comprehensive literature review was carried out in parallel to the primary data collection.

As per the analysis done most of the QA engineers are using Hybrid framework (38%) and Data Driven Framework (34%) while least use the Modular framework and Key Word Driven Framework with a percentage of 14% and 13% respectively. There were seven different issues which arise when using Test Automation Frameworks and each of them were analyzed with the collected data. According to the analysis all most all of the issues which can arise when using a Test Automation Framework depend on the type of the framework used. When considered the frequent dynamic changes it was concluded that apart from the users who are using Modular framework the majority of other framework users are satisfied with the way the framework handles the frequent dynamic changes. Also through statistical analysis it was proved that the number of complaints received after the release of application and the generating and re-running the same test cases according to user inputs and server status depends on the type of framework while the number of changes need to address before releasing the web application does not depend on the type of framework. Although more than 80% of changes need to address before releasing the web application most probably there could be several other factors which could be the reason for this.

In overall, after analysing the different kinds of issues which can arise when using the Test Automation Frameworks, it was concluded that some of the issues straight away depends on the framework but one specific factor did not. The issue that does not depend on type of framework is the number of technical expertise needs outside of the QA team. So this factor can be differed based on different situations like the experience of the developers, facilities given, budget of the project and etc. Also it was concluded that apart from the users who are using Modular framework the majority of other framework users are satisfied with the way the framework handles the frequent dynamic changes.

FOSTERING TEXT MESSAGING FOR MOBILIZATION OF KNOWLEDGE IN EXPORT AGRICULTURE-BASED COMMUNITIES IN THE KURUNEGALA DISTRICT, SRI LANKA

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In a world where the notion of ‘mobilization of knowledge’ has gained much prominence in the recent past, the importance of which to promote sustainable agriculture, from both traditional/indigenous and scientific perspective, is also discussed critically. Yet, one faces the real challenge of using right information and its intellectual assets for this purpose in the most productive way, mainly because of high cost associated with provision of information towards traditional agricultural communities to improve their livelihood. In a situation where, ‘mobile communication’ has experienced an exponential growth and serves as a cost-effective platform for communication in agricultural sector, especially in developing countries like Sri Lanka, this study was aimed to examine empirically the potential use of ‘Text Messaging’ for mobilization of knowledge in the export agriculture-based communities in the Kurunegala district in Sri Lanka.

A personal interview was carried out with a set of farmers (n=85) selected from the North & South Divisions of the Department of Export Agriculture (DOEA) in the Kurunegala district to collect data during April – July 2014. This process was supported by a specific pre-tested structured questionnaire prepared based on the ‘LIRNEasia Teleuse@BOP4’ instrument. Next, a series of field experiments, which were pilot-tested for its accuracy and programmed to run within 3 to 4 months and termed as “Campaigns, were carried out with 142 export agriculture-based farmers during April 2014 to February 2015, where the *FrontlineSMS* – a low cost, user-friendly, free and open source text messaging software, was applied to evaluate the use and relative effectiveness of Campaigns. The outcome of analysis shows that more than 80 percent of farmers in the Kurunegala district use “voice” facility in a mobile phone as a source of information sharing in their day-to-day life. Further, it highlights that text messaging was capable of increasing the volume of information mobilized towards the target group by about 36 percent, and decreases the ‘transaction costs’ associated with provision of information (i.e. search, negotiate and verification costs) to a greater extent. These imply that text messaging can serve as an effective instrument to make positive changes in livelihood of rural communities. Further research is warranted to identify and quantify such changes that occur at different stages in the agri-food value chain since it helps inevitably to develop incentive-based institutional set up working for this purpose.

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EXTENDED BUSINESS SERVICE AND RESOURCE MODEL WITH A RULE BASE

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Business Service and Resource Model (BSRM) is a service modeling approach which provides a framework to model business requirements as services. BSRM is built on the well-known Business Modeling Ontology called Resource Event Agent (REA). It consists of a modeling language and a notation. The current version of the BSRM modeling language has been validated in a few selected areas such as manufacturing and service domain. Even though BSRM is a powerful technique to visualize business functionalities as services which are easily understood by technical and non-technical community, the current version lacks a formal rule base. The major objective of this research is to introduce a rule base to BSRM.

The concepts and relationships among services of earlier version of BSRM were defined in a meta-model which was implemented with ConceptBase tool. Depending on the different functionalities, there were five main service categories defined under BSRM namely, Exchange, Conversion, Sub services, Coordination and Enhance. The rules among concepts when deriving a service category were hidden in the code of the meta-model in the earlier version. In this research, we propose a formal rule base using Object Constraint Language (OCL) which is a declarative language for describing rules. Finally, the BSRM meta-model and the rule base was implemented using Eclipse Modeling Framework (EMF). Here a creation of a java library has been proposed. The new version of BSRM was validated using a real world case, LAUGFS Eco Sri (Pvt) Ltd, which provides emission testing service for vehicles. When comparing to the previous version of BSRM, the new version facilitates the designers by strengthening the consistency among modeling concepts in an efficient way. Ultimate goal of this research is to automate the service modeling process using a service library which is an extension of this study.

INFLUENCE OF MACROECONOMIC AND MONETARY POLICY VARIABLES ON VOLATILITY OF ALL SHARE PRICE INDEX

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Influence of macroeconomic and monetary policy variables on volatility of stock markets is well documented in the literature. However, the impact of macroeconomic and monetary policy variables on volatility of All Share Price Index (ASPI) in Colombo Stock Exchange is rarely studied. Thus, an attempt has been made in this study to fulfill this vacuum, with the key objective being to evaluate the impact of macroeconomic and monetary policy variables on the volatility of ASPI. The focused study period is from January, 2003 to December, 2013 and monthly series were considered to achieve the goal.

The study examines the impact of macroeconomic variables namely, Gross Domestic Product (GDP), Colombo Consumer Price Index (CCPI) and Crude oil prices and monetary policy variables namely, Exchange Rate (ER), Treasury Bill rate (TB), Broad Money supply (M2b) and Average Weighted Deposit Rate (AWDR) on the volatility of monthly ASPI returns. It was found that volatility clusters in monthly ASPI returns are symmetric and therefore symmetric GARCH models were fitted by incorporating the above factors as exogenous variables.

Monthly ASPI returns can be best predicted by AR (4) model and its volatility can be best predicted by GARCH (2, 1) model with inflation and money supply return. Moreover it was found that both inflation and money supply returns are negatively influences on the volatility of ASPI.

A PREDICTIVE MODEL FOR ANNUAL NATIONAL COCONUT PRODUCTION (ANCP) OF SRI LANKA

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The prediction of Annual National Coconut Production (ANCP) is important, since it is a major commercial crop grown across seven agro-ecological regions in Sri Lanka. The climatic variations have a direct influence towards crop production, in addition to long term effects that cannot be attributed to the climate, known as “technology effect”. This study is mainly carried out in order to accomplish the need of updating the current predictive model used in coconut research institute in Sri Lanka (CRISL), and it includes modeling the technology effect and modeling the seasonal climatic effect. Apart from rainfall variables, drought variables such as drought index (SPI) and magnitude (intensity) of drought were considered to have a greater accuracy in prediction. The modeling was done using daily rainfall and coconut yield data in six Agro Ecological Regions (AER) for the period from 1950-2013. The trend due to the technology effect could be assumed to be modeled with a linear function which explained 17.14% of variability of the ANCP. The quarterly seasonal rainfall explained more variability, and also there is a significant correlation between ANCP and climatic variables obtained one year prior to the harvest. With a prior variable selection, the crop climate modeling was carried out using regression, ridge regression analysis. Linear regression implied that the combination of rainfall and drought variables gives a higher variability than using individual factors in the models. However, the combination of the variables caused the multicollinearity problem. To combat the collinearity problem, the Principal component regression (PCR) method, ridge regression methods and liu-type estimation methods were used as biased estimation procedures, since the regular least square estimation is not suitable. Then, the model validation was done and the best fitted model was chosen as the predictive model for ANCP by comparing the available models. In parameter estimation, for the linear regression model, ‘type (3)-liu estimator’ was the most suitable estimator among all other liu-type estimators, with a minimum mean square error, and it gave predictions with percentage errors within $\pm 20\%$. The PCR model gave predictions with $\pm 15\%$ errors. The ridge regression model gave accurate predictions which had less percentage errors (with $\pm 9\%$). Since the predictor variables in the PCR model are linear combinations of climatic variables, it is bit complicated to use in practice. Therefore the linear model with type-3 liu estimators and the ridge regression model could be used to predict the ANCP. When comparing errors of predictions, ridge regression model had less percentage of errors. Therefore the ridge regression model was preferred over the other models. The models would be more accurate, if it could contain even less number of predictor variables.

ON SUPPORT POINTS OF THE CLOSED CONVEX HULL OF A TWO-PARAMETER FAMILY OF ANALYTIC FUNCTIONS

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Let \mathbf{A} denote the set of functions analytic in the open unit disk $D = \{z \in \mathbb{C} : |z| < 1\}$. Then \mathbf{A} is a locally convex linear topological space under the topology of uniform convergence on compact subsets of D . Let \mathbf{F} be a compact subset of \mathbf{A} . A function f in \mathbf{F} is a support point of \mathbf{F} if there is a continuous linear functional J on \mathbf{A} such that $\operatorname{Re} J(f) = \max\{\operatorname{Re} J(g) \mid g \in \mathbf{F}\}$ and $\operatorname{Re} J$ is non-constant on \mathbf{F} . We use $\Sigma \mathbf{F}$ to denote the set of support points of \mathbf{F} .

Let $p > 0$. It is known that

$\mathbf{G}_p = \left\{ \int_{U \times U} \frac{xz}{(1-yz)^p} d\mu(x,y) : \mu \text{ is a probability measure on } U \times U \right\}$ is the closed convex hull of a

family of functions subordinate to functions of a well-known family of functions and that the set of all support points of the family \mathbf{G}_p is given by

$$\Sigma \mathbf{G}_p = \left\{ \int_U \frac{\overline{B(y)}z}{(1-yz)^p} d\nu(y) : B \text{ is a finite Blaschke product and } \nu \text{ is probability measure on } U \right\}.$$

The objective of this study is to find a general theorem, which extends the above result on support points.

Let $F \in \mathbf{A}$ with $F(z) = \sum_{n=0}^{\infty} a_n z^n$ for $z \in D$ and let

$$\mathbf{G} = \left\{ \int_{U \times U} xF(yz) d\mu(x,y) : \mu \text{ is a probability measure on } U \times U \right\}.$$

We prove that if $a_n \neq 0$ for $n \geq 1$ and $\overline{\lim}_{n \rightarrow \infty} |a_n|^{-\frac{1}{n}} = 1$, then the set of all support points of \mathbf{G} is given by

$$\Sigma \mathbf{G} = \left\{ \int_U \overline{B(y)} F(yz) d\nu(y) : B \text{ is a finite Blaschke product and } \nu \text{ is probability measure on } U \right\}.$$

FORECASTING EXTREME DROUGHT EVENTS IN MAJOR COCONUT GROWING AGRO-ECOLOGICAL REGIONS

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Coconut is one of the major plantation crops in Sri Lanka, which is more sensitive to the climatic change. During past few years in Sri Lanka the climate change has been extensively discussed, because it is important to investigate the climate extremes in order to best address their impacts in the agriculture section in future. The main objective in this study is to identify rainfall patterns and forecasting the extreme drought events in major coconut growing agro-ecological regions (AERs) during the monsoon seasons and Yala/ Maha seasons. Daily rainfall data from 1932 to 2011 in 14 rainfall stations from six AERs, DL3, WL2, WL2b, WL3, IL1 and IL3 were acquired from the climate database from Biometry division in Coconut Research Institute.

In this study five descriptive extreme precipitation indices, which are defined by Expert Team on Climatic Change Detection and Indices (ETCCDI) were calculated to identify the characteristic trend of daily precipitation extremes. Mann-Kendall trend test of extreme precipitation indices were revealed that the occurrence of drought events had a significant increase in WL2b region, Ambalantota station in the DL3 region and Horakelle, Palugaswewa stations in IL1 region. In this study the Standard Precipitation Index (SPI) was used as the drought-monitoring tool due to its capability of the monitoring drought events with different time scales. In this study SPI3, SPI6, SPI12 time scale values were calculated and SPI12 time scale was used to obtain the hydrological drought event. It was noted that all stations in WL2b region had highest drought duration and drought severity while Kekanadura station had highest drought duration with -96.58 drought severity. The trend analyses of SPI index were suggested that the occurrence of drought events increase over WL2b region and Ambalantota, Horakelle, Palugaswewa stations. SPI3 and SPI6 time scale values were used to forecast the future drought events station wise for monsoon seasons and Yala/Maha seasons respectively. Autoregressive Integrated Moving Average (ARIMA) and Seasonal Auto Regressive Integrated Moving Average (SARIMA) models were fitted to forecast meteorological droughts in monsoon seasons and Yala/Maha seasons for each station. Cluster analysis for SPI3 and SPI6 time scale data were performed separately to identify drought areas with similar characteristics in the monsoon and Yala/Maha seasons respectively. It was noted that WL2b region, Ambalantota station had similar characteristic dry and wet climatic pattern during the monsoon seasons and Yala/Maha seasons. Time series models were fitted for resulting clustered stations in WL2b region for SPI6 time scales. The fitted time series models of the each station were compared with time series models of the clustered stations. It was identified that fitting time series model to clustered station in WL2b region is more accurate than fitting time series models for individually in each station. It was noted that WL2b region is drought prone AER in Sri Lanka.

SPATIAL ASSOCIATION AND COMPETITION OF TREE SPECIES IN SINHARAJA FOREST

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The importance of inter- and intra-specific competition on structuring tree species is one of the main questions in ecology. Trees compete for same resources and the competition among individuals may leads to low growth rate and survivals at local spatial scales. Classical niche theory assumes that repulsions appear as a result of competition for resources. In contrast, neutral theory assumes that species interactions in tropical forest are weak. In this study, we used spatial patterns of 10 species (from two families: *Melastomataceae* and *Clusiaceae*), their coordinates, and diameter at breast height (dbh), in Sinharaja forest (Sri Lanka), to understand the competition among neighboring trees. Species distribution patterns (random, cluster or regular) were graphically analyzed. However, graphical interpretations are weak. Therefore, “Quadrat count test” was used to check the homogeneity of process. Null hypothesis was rejected at 5% significance level. Hence, species distribution is clustered. Therefore, spatial associations between tree species were tested using Inhomogeneous Ripley’s K-function. First order analysis did not show clear results due to strong habitat heterogeneity presence at the Sinharaja forest. Therefore, bivariate pair-correlation functions were used. This analysis incorporates 45 species pairs to understand their spatial association at radii 0-120m. Most of the species pairs showed repulsion (graphically) at all the spatial scales while very few species pairs showed random pattern. High repulsion pattern has been observed for *Mesua ferrea* (*MESUFE*) and *Mesua nagassarium* (*MESUNA*) with all the other species at almost all the spatial scale. Perhaps, these repulsions are associated to species abundance, species-habitat association and clear spatial structure that prevent other species to mix with them completely. Also, repulsion is expected due to intense competition for resources at small spatial scale for closely related species. However, such repulsions should fade with the spatial scale, but most of the species pairs showed repulsion at all the spatial scale. This is an unexpected outcome. After all, edge effect can cause few species interactions (or species repulsion) at large spatial scales. This outcome favours the niche theory than that of the neutral theory. However, this analysis incorporates all the species pairs and little attention has been paid for the closely related species. Therefore, future studies must be needed to test whether the competition is higher for the closely related genera.

COMPARISON OF THE APPLICABILITY OF FFT AND LPC METHODS FOR NATURAL HUMAN VOICE SYNTHESIS

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The naturalness of the synthetic speech greatly depends on the transitions between neighbor phonemes. Improper transitions between the neighbor phonemes produce auditory discontinuities, which reduce the naturalness of synthetic speech. Most of the existing algorithms, generate speech signals by synthesizing individual phonemes and concatenating them with the assumption that each phoneme is independent from the neighbor phonemes. However, the dependency of a particular phoneme on neighbor phonemes affects the naturalness of speech synthesis. This paper compares the extension of two speech information extraction methods, Fast Fourier Transform (FFT) and the Linear Predictive Coding (LPC) that are used to develop a novel mathematical model to reconstruct the phoneme transitions with high quality at low bit rate. For the study, words containing short /a/ phoneme were considered. Signal peak points were extracted manually from each segment of the sound wave to measure the fundamental frequency. The speech parameters are estimated by applying FFT and the LPC to the quasi-stationary part of the speech wave form. The amplitude and phase values were calculated by considering the dominant poles of the FFT and the LPC for comparison purposes. With the help of these parameters the basic shape of the signal is generated. The envelop of the signal is modeled using a polynomials of different order and the results were compared. White Gaussian noise was applied to generate the noise residuals using the mean and the standard deviation of the noise. Then Pearson's correlation and Spearman rank correlation coefficient between original wave and the reconstructed wave were calculated. Statistical hypothesis tests were conducted to determine the significance of the calculated correlation values. High positive correlations were obtained between source and the reconstruct wave in FFT data extraction method. But in contrast a weaker correlation was obtained in LPC data extraction method. When the order of the polynomial was increased, the correlation values were increased gradually in FFT where as in LPC method, a similar pattern can not be recognized. Even for lower order polynomials, reasonably higher correlation values were observed in FFT. Furthermore, the capacity ratio between the source wave and the proposed method speech parameters were calculated. Resultant capacity ratio values were increased proportional to the polynomial order. Further in this study a threshold value of 0.8 was defined for the correlation coefficient as the acceptance criteria. In FFT method, both correlation values were greater than the defined threshold value for most of the polynomial orders in all transition regions. It also shows that the signals constructed by lower order polynomials have correlation values exceeding the acceptance criteria value. Hence it can be concluded that the transition regions can be modeled as they are, with lesser number of parameters using FFT data extraction method. But in LPC method, all the correlation values were less than the defined threshold value. These reveal that FFT data extraction method produces better results with lesser number of parameters than the LPC data extraction method. Thus this study concludes FFT method extracts the speech information better than the LPC data extraction method and it can be used to model the transition regions with lesser number of parameters.

STOCHASTIC APPROACH IN MODELLING TIMBRE OF SITAR

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The simple first-order linear systems theory of musical instruments is remarkably effective in explaining their acoustic behaviour. Simple impulsively excited instruments such as guitars and bells have nearly linear behaviour, with the fundamental frequency component and all harmonics decaying exponentially with time. Unlike the guitar string, one end of the Sitar string is resting on a curved bridge, which allows the length of the string to vary during vibration. This unique feature, resulting a harmonically rich sound intertwined with buzzing effect which cannot be grasped with the clutches of first-order linear systems theory of musical instruments and making it extremely challenging in modelling and synthesizing the timbre of Sitar. The additive, subtractive and frequency modulation synthesizing techniques, together with the physical modelling approach are incapable in modelling the timbre of sitar successfully due to its time varying nature. The output waveform generated by a musical instrument is known to be a continuous time solution $f(t)$ to a Stochastic Differential Equation (SDE) where $f(t) \in L^1$. The sampled solution to a SDE is necessarily an Auto Regressive and Moving Average (ARMA) process. The output of an $ARMA(p, q)$ process, is a discrete signal. Therefore, naturally it is equivalent to the impulse response of an IIR filter. In Steigtz-McBride algorithm (STMCB), the filter coefficients of corresponding IIR filter is estimated for a given $ARMA$ process while minimizing square sum error. The tone of a single note has been reconstructed by extracting the properties of dominant partials corresponding to the estimated filter coefficients. The algorithm is relatively fast and the convergence is guaranteed for lower order systems. A validation model to compare the synthesized sitar with the acoustic sitars and with the other plucked string instruments has been constructed by using Tristimulates-3, Spectrum Centroid and Zero Crossing Rate algorithms and the results are highly comparable.

CONTRIBUTION OF UNIVERSITY ACADEMICS IN DISSEMINATION OF AGRICULTURAL TECHNOLOGY AND INFORMATION TO THE COMMUNITY AND INDUSTRY

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There are eight Faculties of Agriculture attached to the Universities of Peradeniya, Ruhuna, Rajarata, Wayamba, Jaffna, Eastern, Sabaragamuwa and Uwa- Wellssa offering agriculture related degrees in Sri Lanka. These Faculties possess well-equipped laboratories, different centers and units which could be used in technology dissemination to the end users which is generally known as outreach. The objective of this study was to investigate the contribution of university academics in dissemination of agricultural technology and information to the community and industry with identifying the mechanisms and constraints. A questionnaire was e-mailed and posted to randomly selected 67% of the academic staff members of each the eight Faculties of Agriculture (N = 257) in the state Universities of Sri Lanka, where 126 filled questionnaires (49%) were returned. Thirty five percent of the respondents perceived that their engagement of dissemination activities were very little. Majority (73%) spent less than 5% of their working time for outreach activities in comparison to teaching and research. The major type of involvement during the last 3 years was in trainings conducted for the community. Respondents were involved in trainings (40%), workshops (24%), seminar (17%), and consultancy (14%), and development projects (5%) for community and trainings (25%), workshops (20%), seminar (27%), and consultancy (22%), and development projects (6%) for industry during last 3 years. The average number of activities per academic per year was 1.6 depicting the low involvement of academia in technology dissemination activities. Academics were mostly (44%) coordinating their outreach activities through individual efforts followed by Dean or Heads of the Departments (37%) and 18% through an outreach centre or a team/committee indicating the lack of use or absent of a central outreach mechanism in universities for outreach. Mass media communications of academics were newspapers (27%) radio (23%) and television (12%) which means contribution of academics at least for one mass media were at a satisfactory level. Not having a central mechanism, lack of established network and inadequate infrastructure facilities were the perceived constraints for outreach activities. Only 31% was satisfied about the dissemination activities depicting the need and room for improvements. The general level of involvement of academia in technology dissemination as well as their satisfaction was at a low level. However, the mass communication activities of academics were at a satisfactory level. Major type of technology disseminating is the trainings. Involvement with community is higher than with industry, thereby to improve links with industry also need to be focused. The general mechanism of the academics in engaging in technology dissemination activities was the personal or informal contacts. It would be beneficial to have a formal outreach mechanism in Faculties, in order to promote outreach activities to disseminate agricultural technology and information to the community and industry.

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VALUE-ADDITION AND THERAPEUTIC ENHANCEMENT OF KING COCONUT WATER (*COCOS NUCIFERA* VAR. *AURANTIACA*) BY FERMENTATION WITH KOMBUCHA ‘TEA FUNGUS’

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King coconut (*Cocos nucifera* var. *aurantiaca*) is a variety of coconut, which is known to bear an orange / yellow fruit. Previous studies on the analysis of antioxidant capacity of fruits have revealed coconut water (*Cocos nucifera* L. arecaceae) to possess antioxidant properties. The objectives of this study were to verify the antioxidant and starch hydrolase properties of king coconut water as well as to observe whether any demonstrated therapeutic properties can be enhanced through fermentation of the king coconut water by addition of the Kombucha ‘tea fungus’. The dominant bacterial strain present in the tea fungal mat used for the study were verified and authenticated as *Acetobacter aceti* while the dominant yeast components were identified as *Zygosaccharomyces bailii* and *Brettanomyces claussenii*. King coconut was dehusked and the water was divided into two 500 mL portions. One portion of the obtained water was aseptically inoculated with 3% (w/v) of the freshly grown tea fungus for 7 days at 24 ± 3 °C. The remaining sample was kept under similar aseptic conditions as the control, without being exposed to the tea fungus fermentation. Sampling was carried out only once per day in order to avoid contamination. The colour of the unfermented and fermented king coconut water samples were measured using a Minolta Spectrophotometer CM – 3500d (Minolta Co. Ltd., Tokyo, Japan). The viscosity of the fermented and unfermented water samples were measured using a Brookfield Digital DV-E Viscometer (Middleboro, MA, USA). Measurement of the total phenolics content as well as the Oxygen Radical Absorbance Capacity (ORAC), 2, 2-diphenyl-1-picrylhydrazyl (DPPH•) radical scavenging activity, ferric reducing ability of plasma (FRAP) and 2, 2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS•+) radical cation scavenging activity assays were carried out. The α -amylase and α -glucosidase inhibitory activities were also evaluated. Both bacterial and yeast populations had increased throughout the 7 days which indicated their ability to utilize the king coconut water as a substrate. The fermented king coconut water had a statistically significant decrease ($P < 0.05$) in the pH values on day 1. This was not observed in the control sample. A sharp increase in the lightness was also observed in the fermented sample from day 5 onwards. A statistically significant increase in the total phenolics content ($P < 0.05$) was observed on day 1 in the fermented sample. All antioxidant assays indicated an increase in the fermented king coconut water. The starch hydrolase inhibitory activities of the fermented beverage were observed to have a statistically significant increase ($P < 0.05$) by the end of the fermentation period. There was a better correlation between the total phenolics content and the ORAC values in both samples on all days of analysis ($R^2 = 0.985$ for ORAC vs. $R^2 = 0.745$ DPPH EC₅₀ and $R^2 = 0.632$ for superoxide scavenging potential). In conclusion, the study was able to identify the enhancement of the antioxidant and starch hydrolase inhibitory potential of king coconut water through the addition of the tea fungus. From a health and wellness perspective, the fermentation produced a novelty beverage with enhanced therapeutic properties.

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Not Presented

**AVIFAUNAL DIVERSITY OF LOOKKANDURA ESTATE IN DELTOTA,
CENTRAL SRI LANKA AND ITS SIGNIFICANCE IN
BIRD CONSERVATION**

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The Lookkandura Estate (07° 08' N, 80° 42' E, 1320 m above mean sea level) is said to be the first tea plantation in Sri Lanka. It is mainly surrounded by natural forest patches. As no previous studies have been carried out to evaluate the avifaunal diversity of this area, the present study was designed to evaluate the avifaunal diversity in fragmented forest patches as well as adjoining tea plantations in Lookkandura estate in order to justify the conservation significance of the area. A line transect method integrated with point counts with unlimited distance was used to count birds. Transects were selected according to the local road network with randomly selected starting points. Double counting was avoided as far as possible by maintaining a minimum distance of about 250 m between two counting stations. Data were collected every other week from November 2014 to April 2015. Peak counting hours were between 0600 h – 0900 h and 1500 h – 1800 h. A few night sampling sessions were also conducted to identify nocturnal birds. Binoculars (8 × 40) were used for direct identification of diurnal birds and calls were used to recognize nocturnal birds. Shannon Diversity Index (H) and Simpson's Index of Diversity (1-D) were computed using direct observations to compare the bird diversity in the tea plantations and fragmented natural forest patches.

A total of 98 bird species belonging to 40 families were recorded in Lookkandura area including 10 migratory species, 12 raptor species, three owl species, common and uncommon breeding residents. Among them 59 species and 69 species were recorded in natural forest patches and tea plantations respectively. Tea plantations had high 1-D and H values (1-D = 0.9607, H = 3.6607) than the fragmented forest areas (1-D = 0.9465, H = 3.3792) indicating that tea plantations consist a higher diversity. This may be due to the edge effect of the ecotone which is comprised both of fragmented forest and tea plantation. However, 27 species including 8 endemic species were restricted to the fragmented natural forests. It is significant that 17 out of 33 endemic bird species in Sri Lanka (51.52 %) were recorded in the area. Birds which are commonly found from mid hills up to higher hills such as the Sri Lanka White-Eye (*Zosterops ceylonensis*) and Yellow-eared Bulbul (*Pycnonotus penicillatus*), endangered species such as the Sri Lanka Whistling Thrush (*Myophonus blighi*), globally threatened migratory species such as Kashmir Flycatcher (*Ficedula subrubra*), and vulnerable species such as Mountain Hawk-Eagle (*Nisaetus nipalensis*), Besra (*Accipiter virgatus*), Sri Lanka Wood Pigeon (*Columba torringtoni*), Sri Lanka Myna (*Gracula ptilogenys*), Dull Blue Flycatcher (*Eumyias sordidus*) and Spotted-winged Thrush (*Zoothera spiloptera*) were mainly recorded in natural forest areas. Among the other noteworthy species that were regularly encountered on tea plantations were endangered species such as Streak-throated Woodpecker (*Picus xanthopygaeus*) and Eurasian Blackbird (*Turdus merula*), and vulnerable species such as Hill Swallow (*Hirundo domicola*) and Black-throated Munia (*Lonchura kelaarti*). These results highlight the high conservation value of both natural and tea plantation areas of Lookkandura Estate. Therefore, we recommend that this area be declared as a protected area for the conservation of endemic and endangered bird species.

AVIFAUNAL DIVERSITY IN VALLAI AND THONDAMAN ARU AREAS IN JAFFNA: POTENTIAL FOR ECOTOURISM

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Birding has become a popular form of ecotourism in many parts of the world. The Jaffna peninsula is home to many species of migratory and resident waterfowl. Given the fact that the Jaffna Peninsula was inaccessible to the public due to the three-decade long civil war, its ecotourism potential has not been evaluated. Hence the overall objective of the study was to evaluate the ecotourism potential of two sites in Jaffna - Vallai and Thondaman Aru - in terms of their bird species richness. The study was carried out from December 2014 to May 2015, with two counting days per month. We used point counts with unlimited distance for assessing the diversity and abundance of birds. Each area had a minimum of five point counting stations, with each station separated from the next by at least 250 m, to prevent double-counting. Standard birding binoculars (8 × 40) and a 25 × 50 spotting scope were used to observe the birds. Peak counting hours were from 0630-1000 h and 1530-1800 h. Each count lasted for about 20 minutes.

A total of 66 and 37 bird species (both resident and migrant) were recorded from Vallai and Thondaman Aru areas respectively. Vallai was home to 21 migrant species and Thondaman Aru had 16 migrant species. Seven uncommon winter migrants (33% of total migrant species recorded) were recorded in Vallai. Among the rare species were the Whimbrel (*Numenius phaeopus*), Eurasian Curlew (*Numenius arquata*), Greater Sand Plover (*Charadrius leschenaultia*), Green Sandpiper (*Tringa ocheopus*), Black-headed Gull (*Chroicocephalus ridibundus*), and Common Teal (*Anas crecca*). Five uncommon winter migrants (31.25%) were recorded from Thondaman Aru, and one very rare migrant, the Common Ringed Plover (*Charadrius hiaticula*) was also recorded. These species hold a high ecotourism potential given their rarity. The Greater Flamingo (*Phoenicopterus roseus*), which is now uncommon in Sri Lanka and present in fluctuating numbers, was recorded in high numbers in both areas (600+ in Vallai and 467 in Thondaman Aru). The most abundant migrant species was the Northern Pintail (*Anas acuta*) with 754 individuals. The most numerically abundant species in both sites was the Little Cormorant (*Phalacrocorax niger*) with 2,232 individuals in Vallai and 1,381 individuals in Thondaman Aru. The presence of the Spotted-billed Pelican (*Pelecanus philippensis*), which has fewer than 1,000 breeding pairs in Sri Lanka, in large numbers (369 in Vallai and 204 in Thondaman Aru) is significant for conservation, given the fact that sites that support at least 1% of the national population of a species are deemed nationally important. Since these two sites also hold at least 1% of the global population of this species (~13,000), these are also internationally important sites. Thus it is apparent that both Vallai and Thondaman Aru areas in Jaffna hold a high ecotourism potential in terms of bird species diversity. We recommend that these sites be declared as nationally or internationally important waterfowl habitats.

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1D COORDINATION POLYMER OF Zn(II) FOR THE DETECTION OF AIRBORNE AMMONIA THROUGH ON/OFF PHOTOLUMINESCENCE

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NH₃ is one of the natural gases present in our atmosphere in relatively low concentrations. However, due to human activities these low or sub ppb levels have been significantly increased in the past. Sensing of NH₃ is useful for many reasons, such as unpleasant odor and health threats to both humans and animals when present in high concentrations. Thus, many types of NH₃ sensors were developed by researchers based on metal-oxides, conducting polymers, optical materials and various other types of chemical reactions etc. However, low sensitivity, large device size, high cost and difficulties in handling are the few drawbacks reported in most of these detectors. Luminescence vapochromism is the ability of a compound to change its photoluminescence properties upon encountering a gas or a volatile compound due to various reasons, making changes in the emission spectra. Metal complexes composed of strong-field coordination donors such as O, N, P, or S atoms, can show this phenomenon very frequently. Main application of such compounds is the preparation of sensors to monitor the presence of harmful gaseous or volatile chemical substances present in the environment. Surprisingly, NH₃ gas sensors reported based on this phenomenon were few, though there were many reports available on the detection of volatile organic compounds (VOC) based on luminescence vapochromism. Thus, an effort has been taken to synthesize an NH₃ sensor based on this phenomenon.

A 1D coordination polymer based on the complex, aqua (1,10-phenanthroline) bisterephthalatozinc(II) [Zn(phen)(H₂O)(terep)₂] was synthesized by the solvothermal method using DMF. This coordination polymer exhibited pink luminescence on excitation at 256 nm and it became non-emissive permanently upon exposure to NH₃ vapour. Single crystal X-ray diffraction data revealed that the polymer has units composed of Zn(II) centers with ligands arranged in distorted trigonalbipyramidal structure and belonged to *P* $\bar{1}$ space group. These zinc units are linked by terephthalate ligands giving rise to 1D zig-zag chains which then arrange in a 3D structure revealing lots of space for ammonia to be trapped in. The reaction was found to be irreversible, whereas most of host guest trapping reactions are usually thermally reversible. Further, IR data did not show any peak for the presence of ammonia and also PXRD data revealed new peaks in the pattern of the product indicating that the reaction is not a simple reversible trapping reaction, but a different one which involved changes in the coordination sphere of Zn. Moreover, the polymer also showed reversible pink to non-emissive change in photoluminescence with other nitrogen containing larger compounds; EtNH₂, Et₂NH, Et₃N and aniline but only with a drop of the compounds, which suggests a quick guest trapping and de-trapping interaction with larger molecules. As this irreversible ON/OFF luminescence behavior was observed only towards NH₃ vapour, this polymer can be improved further to detect NH₃ in the environment and be developed as an NH₃ sensor.

PRELIMINARY STUDIES ON FROG-BITING MOSQUITOES (CULICIDAE) IN SRI LANKA

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Most mosquito species (Culicidae) prefer endothermic animals to obtain a blood meal. A few species, however, feed on ectothermic amphibians and reptiles which potentially serve as competent reservoirs of arboviruses and blood parasites, despite their potential importance in disease dynamics. The objective of our study was to report the ectotherm-biting mosquitoes which are attracted to amphibian hosts in Sri Lanka. For the preliminary investigation three study sites were selected at the premises of the University of Peradeniya. These sites were ideal for this investigation given their high abundance of anurans which includes *Duttaphrynus melanostictus*, *Polypedates cruciger* and *Limnonectes limnocharis*.

The study was carried out from February 31st to May 31st 2015. The observations of biting behavior and mosquito collections were done from 8.00PM to 10.00PM, three days per week. To investigate host specificity, blood fed mosquitoes were collected directly from individual frogs using an insect aspirator. Total 300 individual frogs (100 from each species) were observed to collect mosquitoes. Sound traps broadcasting frog calls of *D. melanostictus* or *P. cruciger* were used to collect insects attracted to frog calls, a known strategy shown by some anuran feeder specialists. The specimens collected were euthanized in a freezer and later transferred to 70% alcohol for identification. Host location, response to host cues and biting behavior of the mosquitoes were video recorded using a night vision video camera. Our observations and video analysis data showed that there are mosquitoes that preferentially bite anurans and locate their host by responding to the mating calls of male frogs. A total of 600 mosquitoes were collected, from which 40% were aspirated directly from the frogs' body. The remaining 60% were captured using sound traps. Morphological identification showed that all these mosquitoes belong to the genus *Uranotaenia*. The specimens are not, however, *Uranotaenia lowei* which is a well-known frog biting mosquito throughout the world. Our results revealed the presence of two species (U. species "A" and U. species "B") of which, 99% of the individuals were Species "A" and only 1% were species "B". Both species were observed feeding more often on *D. melanostictus* (99%) than *P. cruciger* (1%). These mosquitoes, however, were not observed biting *L. limnocharis*.

The present study reports, for the first time in Sri Lanka, the presence of frog-biting mosquitoes which locate their host by responding to anuran calls. Future studies will focus on the use of molecular barcoding techniques to determine the species identity of these mosquitoes. We will also extend the study to other parts of the country to explore the diversity, distribution and ecology of Sri Lankan frog-biting mosquitoes.

RELEASING OF LYCOPENE FROM LYCOPENE-CYCLODEXTRIN- Al³⁺- MONTMORILLONITE CLAY COMPOSITE AT SIMULATED GASTRIC AND INTESTINAL pH VALUES

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Lycopene, which is present as a deep red pigment in tomato, watermelon and pink grapefruit, is an acyclic unsaturated carotenoid having strong antioxidant properties. However, lycopene has low oral bioavailability because of its extremely high lipophilicity. With a view to enhancing the bioavailability of lycopene, various encapsulation methods have been investigated in order to produce slow-releasing formulations of lycopene. In the present study, Al³⁺-exchanged montmorillonite (MMT) clay was investigated as a matrix to trap lycopene (LYC) with the mediation of β -cyclodextrin (β -CD) and to release lycopene from the composite at simulated gastric and intestinal pH values. Al³⁺-exchanged MMT clay was prepared by treating MMT with aqueous AlCl₃, employing standard procedures. Lycopene (LYC) was isolated from tomato by solvent extraction using a mixture of hexane:acetone:ethanol (2:1:1; v/v). A solution of lycopene in acetone was mixed with an aqueous suspension of β -CD and the cation-exchanged clay to obtain LYC- β -CD-Al³⁺-MMT. Buffer solutions of pH 7.4 (simulated intestinal fluid) and pH 1.2 (simulated gastric fluid) were prepared. LYC- β -CD-Al³⁺-MMT was immersed in the buffer solution and the amount of lycopene released was determined by measuring the absorbance of a chloroform extract of the supernatant by UV-Vis spectroscopy at 471 nm. The amount of lycopene releasing increased with time in both simulated gastric and intestinal fluids. Minute releasing (~4 ppm) of lycopene was observed in simulated gastric fluids (pH 1.2) and significant releasing (~50 ppm) of lycopene was observed in simulated intestinal fluids (pH 7.4) after 6 h. It can be concluded that β -CD-Al³⁺-MMT enables the entrapped lycopene to pass through the acidic stomach and reach the intestine in controlled dosage forms where lycopene is released. Therefore, this approach may be effectively used for the oral administration of lycopene to enhance its therapeutic efficacy.

GASTROINTESTINAL PARASITES OF MAMMALS IN DEHIWALA NATIONAL ZOOLOGICAL GARDENS OF SRI LANKA

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Parasite diseases constitute one of the major problems in zoological gardens around the world causing mortality in animals while in captivity. A cross sectional study was carried out to determine the prevalence, intensity and the types of gastrointestinal (GI) parasites of captive mammals in the Dehiwala National Zoological Gardens in Sri Lanka (The Zoo hereafter). Fresh faecal samples (~10 g) were collected from seventy mammal species in Dehiwala Zoo belonging to nine orders: Primates, Carnivora, Perisodactyla, Artiodactyla, Proboscidea, Erinaceomorpha, Lagomorpha, Rodentia and Diprotodontia. Sample collection was done in the morning, at about 8.00 am, before the cages were cleaned by the keepers. Samples were collected from January to October 2014 and each animal was sampled only once. Faecal samples were analyzed using a modified salt floatation method, Sheather's sucrose floatation method, iodine and direct smears to capture all the helminth eggs and protozoan cysts. Faecal cultures were prepared to isolate parasite larvae. Species identification was done morphologically using standard keys and some were confirmed by molecular analysis. Intensity of parasite infections was determined using the McMaster technique. Of the 70 samples analysed, 44 (62.9%) were positive for GI parasites. Although the prevalence of helminth infection was higher (51.4%) compared to protozoan infections (30.0%) this difference was not statistically significant (Chi square test; $p > 0.05$). A total of 14 types of GI parasites were recorded: *Trichuris* sp., strongyle type, *Strongyloides* sp., *Toxocara* sp., hookworm, *Spirometra* sp., *Moniezia* sp., *Nematodirus* sp., *Giardia* sp., *Blastocystis* sp., *Balantidium* sp., *Entamoeba* sp., coccidians and unknown protozoan cysts were observed. The most common infection was strongyle type (17.1%) followed by *Entamoeba* sp. (14.3%). Of the infected individuals, 25.0% had mixed infections. High worm burden was recorded in silver leaf monkey (*Trachypithecus cristatus*), Hamadryas baboon (*Papio hamadryas*), African lion (*Panthera leo*), black rhino (*Diceros bicornis*), pony (*Equus caballus*), porcupine (*Hystrix* sp.) and flying squirrel (*Pteromyini* sp.). Among the nine mammalian orders, individuals of seven orders were infected with one or more GI parasites whereas lagomorphs and diprotodonts did not have any parasites. The presence of parasites in the faecal sample does not mean the animal is sick or will be sick nor does it mean that the animal should be treated. All GI parasites are not equal; some are highly pathogenic like *Nematodirus* sp., *Trichuris* sp. and some are incidental. The current practice at The Zoo is to treat every animal routinely giving anthelmintics every three months. The importance of a better control strategy with a targeted approach to manage parasites effectively is highlighted. Pathogenic species should be treated after regular faecal examination along with administration of specific treatment at regular intervals.

DIVERSITY OF COCCINELLID BEETLES IN SELECTED CROP FIELDS IN THE KANDY DISTRICT, SRI LANKA

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Coccinellid beetle is one of the potential predatory species prey on aphids, mealy bugs, whiteflies and leaf hoppers. About 6000 coccinellid species (Coleoptera : Coccinellidae) were reported throughout the world. They are distributed in all countries in Asia. Fifteen different coccinellid beetle species belonged to twelve genera of four tribes and three sub families have been recorded in Sri Lanka. Coccinellid beetles are one of the promising predatory species to use in augmentation and field release. Prior to develop a release programme, it is necessary to assess the diversity of coccinellids under field conditions; therefore, this study was conducted with the objectives of assessing the diversity of coccinellid beetles. Field survey was carried out in Dodangolla, Galagedara, Gannoruwa and Kundasale vegetable fields (Brinjal, Bean, Dambala, Pole Bean, Manihot, Cabbage, and Tomato) in mid country region of Sri Lanka. During the survey samples were taken weekly over a period of 6 weeks. Samples were taken by using a same quadrat (1 x 1 m) in randomly selected places in the vegetable fields early in the morning (8.00 am). Identification was done through examination of morphological features of beetle species and comparing with the images in pictorial guide. Insect diversity was assessed by using Shannon-weaver diversity index. The abundance was calculated by using SYSTAT SPSS software. A total of seven coccinellid beetle species: *Scymnus* spp., *Coccinella octomaculata*, *Micraspis discolor*, *Illeius cincta*, *Coccinella transversalis*, *Cryptolaemus* spp. and *Anegleis cardoni* were found in all crop cultivations. The abundance of species significantly varied ($X^2=301.1$ df =6 $P<0.05$) with the crops: brinjal, bean, dambala, pole bean, manihot, cabbage, and tomato. The highest coccinellid beetle diversity was recorded in the pole bean at Gannoruwa ($H'=2.2116$) and Galagedara ($H'=1.4771$). The lowest recorded from the tomato in Galagedara ($H'=0.4515$). The highest species abundance was found in pole bean and *Micraspis discolor* was the most abundant species in pole bean. The crops with low diversity and low abundance of Coccinellid species can be considered as crops that could use augmentative release as an approach of biological control.

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**ALL PARASITES ARE NOT EQUAL:
DIFFERENTIAL EFFECT OF EXPOSURE TO NINE CERCARIAE
TYPES ON COMMON HOURGLASS TREE FROG**

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Cercariae of digenetic trematode *Ribeiroia ondatrae* have been identified as the probable cause of widespread limb malformations in amphibians in the North America. Laboratory exposure to cercariae of *Acanthostomum burminis*, a trematode that infect water snakes, induces malformations and mortality in tadpoles and metamorphs of the common hourglass tree frog, *Polypedates cruciger* and the Asian common toad *Duttaphrynus melanostictus*. The present study investigates the effect of exposure to cercariae of different trematodes on survival, growth and development of malformations in *P. cruciger* under laboratory conditions. Eggs of *P. cruciger* were brought to the laboratory and the tadpoles were raised in glass aquaria. Cercariae released from freshwater snail, *Melanoides* sp. were isolated, stained with Borax Carmine and identified under the light microscope. Snails shedding cercariae were placed inside the aquarium containing 10 days post-hatch tadpoles (Gosner stage 27/28) of *P. cruciger*. Mortality, growth [snout-to-vent length (SVL) and body mass], growth rate assessed as the time required for fore limb emergence of half of the number of tadpoles (TE₅₀) and development of any malformations were recorded in tadpoles and metamorphs. Malformed tadpoles and metamorphs were preserved and the skeletons were stained. A total of nine types of cercariae: three gymnocephalous (types A, C, D), one distome (type B), one oculopleurolophocercous (type F), two xiphidiocercariae (types E, G) and two pleurolophocercous (types H, I) Tadpoles exposed to cercariae types H and I had a significantly lower survival compared to that of the control (Chi Square test, $p < 0.05$). Tadpoles exposed to cercariae types C, H and I developed malformations. Tadpoles and metamorphs exposed to cercariae types H and I developed kyphosis (hunched back) and scoliosis (curvature of the spine) and they were also visible in the stained skeletons. Tadpoles exposed to cercariae type C had an open wound in the belly area. Moreover, tadpoles exposed to cercariae types H and I took more time to metamorphose with a significantly high TE₅₀ compared to its control (ANOVA GLM, $p < 0.001$). There was no difference in the survival (Chi Square test, $p > 0.05$) or TE₅₀ values (ANOVA GLM, $p > 0.05$) in the tadpoles exposed to cercariae types A, B, D, E, F, and G. They didn't develop any malformations either. None of the cercariae had any effect on the growth of the tadpole. Of the nine types of cercariae, only three types induced malformations and increased mortality and lengthened the larval period while exposure to other six types had no effect on *P. cruciger*. This shows that cercariae induced effects of all the digenetic trematodes are not equal, only some affect the growth, development and survival of amphibians.

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LIFE CYCLE OF *RHIPICEPHALUS HAEMAPHYSALOIDES* SUPINO, 1897 (ACARI: IXODIDAE) UNDER LABORATORY CONDITIONS**G.C.P. Diyes^{1,2} and R.S. Rajakaruna^{2*}**¹*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*²*Department of Zoology, Faculty of Science, University of Peradeniya, Sri Lanka*
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Rhipicephalus haemaphysaloides is a medically and veterinary important three host, hard tick (Family Argasidae) that infests wider range of wild and domestic animals and occasionally humans. It is considered the third most abundant tick found among domesticated animals in Sri Lanka and has been identified as a tick with great potential to transmit Kyasanur Forest disease (KFD) virus in India. Even though this tick has a limited distribution in the world it has widely dispersed over the Oriental Region. Present study was carried out to determine the life cycle pattern of *R. haemaphysaloides* population in Sri Lanka as it is important in determining the epidemiology of tick infestations and tick-borne diseases and in controlling tick populations. Engorged adult female ticks were collected from dogs in Anuradhapura District and were maintained under laboratory conditions (at 28±1 °C, 80% RH). Biological parameters of parasitic phase of the larvae, nymphs and adults were determined by rearing them on albino rabbits. Engorged females had a mean weight of 295.6(±195.1) mg and completed oviposition in 16.1(±3.7) days with an average pre-oviposition of 6.5(±1.1) days. Average number of eggs laid by a female was 4,067.4(±3136.2). A strong positive correlation was observed between body mass and the number of eggs ($r = 0.94$, $P < 0.05$). The number of eggs laid was initially low but increased rapidly to a peak on day 3 (females above 200 mg), and then gradually declined. Minimum incubation periods at three different temperatures 22°C, 28°C, and 32°C were 30.5(±3.2), 25.4(±0.8) and 19.2(±0.7) days, respectively and the incubation success at 28±1 °C was 92.6%. Majority (86.9%) of larvae successfully moulted to nymphs with an average pre-mouling period of 7.9(±0.7) days. Larvae had a parasitic period of 3.2(±0.5) days and survived 103.4(±19.8) days. Naturally detached nymphs had a mean weight of 5.7(±1.7) mg and majority (76.6%) successfully moulted within 18 days with an average pre-mouling period of 15.1(±1.9) days. Average weight loss during moulting was 2.6(±0.7) mg. Nymphs completed the blood meal after 3.7(±0.9) days. Unfed nymphs survived 45.8(±3.8) days. All the nymphs with average weight of 6.6(±1.6) mg moulted into females while nymphs with average weight of 4.7(±1.3) mg moulted into males. Female nymphs had a higher body weight compared to male nymphs (Student's *t* test; $P < 0.05$). Body weight of adult females increased 114 times than their initial weight during feeding which lasted for 13.3(±1.3) days. *R. haemaphysaloides* completed the life cycle in an average of 91.2 days. Although a significant relationship was observed between the engorged weight of nymph and the resulting adult sex, weight cannot be taken as a powerful predictor for sex because of the overlapping weights of male and female nymphs. Life cycle of Punjab, Tamil Nadu and Malaysian populations of *R. haemaphysaloides* has been documented. The life cycle pattern of *R. haemaphysaloides* in Sri Lanka shares similarities with geographically closer Punjab and Tamil Nadu populations.

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CROSS SECTIONAL SURVEY OF GASTROINTESTINAL PARASITES OF DOMESTICATED AND FERAL HORSES AND PONIES (*EQUUS CABALLUS*) IN SRI LANKA

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Horses and ponies are not native to Sri Lanka. Tamed horses are continuously imported to Sri Lanka from few neighboring countries and are used for police work, sporting and esthetic purposes while feral horses are confined to Delft Island. Although many studies have been conducted on gastrointestinal (GI) parasites of horses world-wide, GI parasites of equines in Sri Lanka have never been documented. We carried out a cross sectional survey of GI parasites in domesticated and feral horses and ponies in Sri Lanka. Fresh faecal samples were collected from horses and ponies from January to August 2014. Qualitative analyses using direct saline and iodine mounts, simple test tube flotation, Sheather's modified sucrose flotation method and sedimentation technique were carried out followed by quantitative analysis using McMaster counting technique for the positive samples. Identification of parasites involved morphological, morphometric measurements and standard keys in literature and confirmed using molecular methods. A total of 73 faecal samples were collected from domesticated (45) and feral (15) horses and domesticated ponies (13). A high overall prevalence (43.8%) of GI parasites was recorded of which all the feral horses were infected while only 26.1% of domesticated horses were infected. Among the domesticated horses and ponies, a higher prevalence of protozoan infections (25.0%) was recorded than helminth infections (8.9%). A total of six types of parasites: three helminths (*Anoplocephala* sp., *Parascaris equorum* and *Strongylus* sp.) and three protozoans (*Entamoeba* sp., *Giardia* sp. and *Isospora* sp.) were recorded. *Strongylus* sp. was the most common helminth group recorded where all the feral horses were infected with *Strongylus* with high worm burden (500-1600 EPG) but not any of the domesticated animals. *Strongylus* is the most common and most damaging parasite of horses worldwide. Among the parasites recorded in horses and ponies *Entamoeba*, *Giardia* and *Isospora* are zoonotic infections. The study highlights that none of the domesticated horses harboured any highly pathogenic GI parasites but feral horses in Delft Island were infected with all six types of GI parasites with high intensities and of which *Gairdia* and *Strongylus* infections can be considered important. Many deaths of feral horses have been reported from the Delft Island and it is important to monitor the cause of mortality, especially because the Island is soon to be declared a National Park by the Department of Wildlife Conservation mainly because of the presence of these feral horses.

DEVELOPING BIRD-BASED ECOTOURISM IN JAFFNA: A CASE STUDY ON MANGROVE HABITATS ON THE ISLANDS OF MANDAITIVU AND SIRUDIVU

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Mandaitivu and Sirudivu are two islands that are notable for their bird diversity in the Jaffna peninsula. Mangrove ecosystems provide suitable habitats for a large number of bird species. Although such environments have high ecotourism potential, the area has not been evaluated previously, may be due to the three decade long civil war. Thus the present study was designed to measure the avifaunal diversity associated with these mangroves and its importance in terms of ecotourism potential. Bird censusing was carried out from September 2013 to April 2014 and September 2014 to May 2015, when migratory species were present in the area. Point transects were used to count birds. For observing birds, 8 × 40 standard birding binoculars and a 25 × 50 spotting scope were used. Peak counting hours were between 0630 and 0830 h each day, and counts were taken weekly. A 10 km² area was selected from each habitat and six sampling points were selected using simple random sampling. A minimum distance of approximately 250 m was kept between any two points to avoid double counting. Birds were counted for 20 minutes at each point.

A total of 37 species of birds were recorded from Mandaitivu and Sirudivu during the study period. Among them were uncommon breeding residents including the Spotted-billed Duck (*Anas poecilorhyncha*) and Little-ringed Plover (*Charadrius dubius*) and uncommon winter migrants including the Greater Flamingo (*Phoenicopterus roseus*), Green Sandpiper (*Tringa ochropus*), and Western Reef Egret (*Egretta gularis*). The highly endangered Slender-billed Curlew (*Numenius tenuirostris*) and the Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*), both of which are winter vagrants to Sri Lanka, the very rare Wood Snipe (*Gallinago nemoricola*), Wood Sandpiper (*Tringa glareola*), and Pintail Snipe (*Gallinago stenura*) were also observed during this study. The fact that the Greater Flamingo had the highest count of any species of bird on Mandaitivu (with 612 individuals) is significant since this species is a much sought after species by ecotourists. Among the resident species, the Spotted-billed Duck, which is found only in the northern parts of the Island, holds a high ecotouristic potential given its rarity. Of the total of 21 species of true mangrove plants in Sri Lanka, four species were identified as being the most common on both islands. These were *Avicennia marina*, *A. officinalis*, *Rhizophora mucronata*, and *Ceriops tagal*. The dominant species on Mandaitivu were *A. marina* and *A. officinalis* and the latter was found only on Sirudivu. Mandaitivu area is not only covered with mangroves but also with different types of salt marshes. In conclusion, it can be said that both these areas are potentially very good ecotourism destinations given the extent of the mangrove habitats and the presence of uncommon and endangered bird species, both resident and migrant. It was found that period from November to May was the best time of the year for visiting ecotourists. Unfortunately, at present, road development and hotel construction have negatively impacted on these prime avian habitats. This is especially true for the habitat of the very rare Spotted-billed Duck. Hence we recommend that both these areas be declared as protected areas for the conservation of mangroves and associated bird diversity as well as for the promotion of bird-based ecotourism in the Jaffna peninsula.

INTERCALATION OF ALKALOIDS OF *MURRAYA KOENIGII* INTO H⁺ AND Al³⁺ EXCHANGED MONTMORILLONITE CLAYS

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Montmorillonite (MMT) is a layered alumino-silicate mineral in which a central octahedral alumina sheet is sandwiched between two tetrahedral silicate sheets. The surface of the sheets exhibit a negative charge, enabling it to take up different cations which can be easily replaced by other positively charged molecules. Cation-exchange with H⁺ and Al³⁺ would introduce Lewis and Bronsted acid sites in MMT clays and such clays have the potential of trapping alkaloid molecules. In this study, the cation-exchanged clays were used to trap alkaloids present in the leaf extract of *Murraya koenigii* (L.) Spreng. (curry-leaf tree). The leaves contain carbazole alkaloids such as mahanimbine, girinimbine, isomahanimbine and koenimbidine which are biologically important due to their antibacterial, anti-inflammatory, anti-diabetic, anti-ulcer and hypolipidemic properties.

Intercalation of alkaloids into MMT was carried out using the direct leaf extract as well as the separated alkaloid fraction. The leaf extract was obtained by extracting the dried leaf powder into methanol using a Soxhlet apparatus and the alkaloid fraction was obtained using acid extraction method. Alkaloids present in both the leaf extract and the separated alkaloid fraction were intercalated into H⁺ and Al³⁺-exchanged MMT separately. The alkaloid content present initially--before intercalation--and in the supernatant after intercalation was determined quantitatively by UV-visible spectroscopy using the ion-pair method. A coloured ion-pair complex was formed by reacting the protonated alkaloid with methyl orange. Measurements were carried out at 430.5 nm at an optimum pH of 4.5. Qualitative analysis of alkaloids was carried out using Thin Layer Chromatography. The trapping of alkaloids was confirmed by the release of alkaloids using NaOH. All clays before and after intercalation were characterized using X-ray diffraction (XRD) and Infrared spectroscopy (FT-IR).

The results indicated successful trapping of alkaloids where H⁺-MMT and Al³⁺-MMT trapped 80% and 65% of the alkaloids present in the methanolic leaf extract and 74% and 76% of the alkaloids present in the separated alkaloid fraction, respectively. Stirring the leaf-extract-intercalated clay in NaOH released 84% and 92% of alkaloids from H⁺-MMT and Al³⁺-MMT, respectively, within a period of 6 h. Stirring the alkaloid-fraction-intercalated clay in NaOH released 87% of alkaloids from H⁺-MMT in 1 h and 90% of alkaloids from Al³⁺-MMT in 2 h. It can be concluded that the alkaloids present in the leaves of *Murraya koenigii* can be successfully intercalated into cation-exchanged MMT and the intercalated alkaloids can be released upon alkali treatment.

DIVERSITY AND ABUNDANCE OF QUESTING TICK SPECIES IN HANTANA AND RANDENIGALA FOREST RESERVES IN SRI LANKA

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The ecology of ticks, the outcome of their interactions with their natural environment is fundamental to the spatial and temporal variation in the risk of infection by tick-borne pathogens. Ticks act as vectors of zoonoses and they are major factors contributing to the appearance of new zoonotic pathogens in human populations due to increased contact between humans and wildlife. Objective of this study was to assess the questing tick species composition in Hantana (wet zone) and Randenigala (intermediate zone) forests and in the adjoining pastures in the Kandy district with relation to rainfall, relative humidity and temperature. Questing ticks were collected from forests and adjoining pastures in two localities in Hantana and Randenigala once a month using a white flag for a period of one year. In each locality two plots, each with an area of 1000 m² were selected inside the forests and two in the adjoining pastures. Each plot was visited once a month. Ticks were collected from 0900 to 1200 h. To determine the diurnal variations, collections in the other two plots were carried out in the evenings from 1300 to 1600 h. Temperature and relative humidity were recorded at the time of collection in each plot. Monthly rainfall data was taken from the Metrological Department. Ticks were stored in vials containing 70% ethanol. Larvae, nymph and adult of male and female ticks were identified using available keys. A total of 8916 questing ticks were collected from the forest and forest boarder pastures and 13 tick species were identified. They were *R. haemaphysaloides*, *R. sanguineus*, *A. testudinarium*, *A. integrum*, *H. cuspidata*, *H. aculeata*, *H. spinigera*, *H. bispinosa*, *H. intermedia*, *H. kysanurensis*, *H. turturis*, *D. auratus*, and *I. petauristae*. Identification of 6 immature tick species belonging to genus *Haemaphysalis* and one species of genus *Amblyomma* was uncertain. *Amblyomma* larvae which were collected from inside the forests closely resembled *A. clypeolatum*. Forty adults were collected during dry periods from forests and pastures. *H. spinigera* was the most abundant species in both sites (Hantana 21.2%, Randenigala 23.4%) followed by *H. aculeata* (14.9%), *R. haemaphysaloides* (12.4%) and *H. cuspidata* (10.9%) in Hantana and *H. bispinosa* (10.5%) and *D. auratus* (10.4) in Randenigala. Only larvae stages of *D. auratus* were questing in both sites. Larvae of *I. petauristae* were the most scarce tick species in both sites (Hantana 0.6% and Randenigala 0.7%). Immature unidentified *Amblyomma* sp, were found from Hantana which were not present in Randenigala. On the other hand, adults of *H. kysanurensis* was found only from Randenigala. Most abundant tick species found in domestic pastures were immature *D. auratus*, and *A. testudinarium*. Higher abundance of questing ticks on pastures comparative to inside the forest shows that dropping off ticks from the host, and egg laying is higher while grazing and resting in pastures than moving across the forest. Questing activity was higher during dry periods compared with rainy days and in the evenings than mornings. The questing ticks, which were collected during evenings revealed that the questing activity is higher in the evenings and the numbers of ticks attacking humans are significantly higher during evenings than mornings.

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DEATH, STUNTING, DELAYED METAMORPHOSIS AND MALFORMATIONS: PERNICIOUS EFFECTS OF COMMONLY USED FUNGICIDE “MANCOZEB” ON *POLYPEDATES CRUCIGER* TADPOLES

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The heavy usage of biocides, one of the major perturbations in nature, has polluted water bodies in agricultural regions in Sri Lanka, posing a threat to the endemic aquatic organisms such as amphibians mostly anurans. Effects of Mancozeb, a leading fungicide used in Sri Lanka, on growth, survival, metamorphosis, and development on the tadpoles of *Polypedates cruciger*, an endemic tree frog were evaluated; we also evaluate the lethal and sub-lethal levels, determine vulnerable stages of tadpoles. Hundred tadpoles each of *P. cruciger* at Gosner stage 24 (7 days after hatching; early-stage exposure) and 29-31 (30 days after hatching; late-stage exposure) were obtained from a single clutch of eggs. Two concentration series of Mancozeb were prepared as follows: Control (dechlorinated water only), Control+DMSO (solvent of Mancozeb), 0.01 µg/ml, 0.05 µg/ml, 1.0 µg/ml. Ten tadpoles each were introduced to the two concentration series (early-stage exposure and late-stage exposure); tadpoles were raised separately. Following data was obtained for each individual after 24 weeks of exposure: length of the tadpole (determines growth) was taken once in two weeks, abnormal behaviors, mortalities, metamorphs and malformations were observed daily. ANOVAs for growth rates in early stage exposure show that they were significantly different between treatment levels as $p < 0.05$, and the discriminant analysis showed a high proportion as correct (0.81). But in later stage exposure those were not significantly different as $p > 0.05$. The discriminant functions analysis showed a lower proportion of correct separation (0.781). In early-exposure 0.05 µg/ml and 1.0 µg/ml concentrations tadpoles showed diminished feeding activity, but in late-exposure tadpoles this was not apparent. The survival of late-exposed tadpoles was greater when compared to early-exposed tadpoles at higher Mancozeb concentrations (0.05 and 1.00 µg/ml). In early exposure 100% mortality was observed in both 0.05 µg/ml and 1.0 µg/ml concentrations; in late-exposure mortality proportions were only 10% and 30%, respectively for 0.05 µg/ml and 1.0 µg/ml concentrations. These mortalities were significant among the treatments in early-stage exposure as $p < 0.05$ in chi-square test but in late-stage exposure, there was no significant mortality between groups, as $p > 0.05$ in chi-square test. 0.05 µg/ml and 1.0 µg/ml Mancozeb treated tanks 0% metamorphoses in early exposure and 40% and 60% metamorphoses occurred respectively in later stage exposure. Common malformations seen among tadpoles in 0.05 µg/ml and 1.0 µg/ml Mancozeb treated tanks were *Scoliosis*, *Kyphosis*, *Primary bone rotation*, *absence of one forelimb* and *twisted and tangled hind limbs*. The work shows that Mancozeb can cause mortalities directly, reduced growth rates, abnormal behaviors, and low numbers of metamorphs and development of malformations mainly in early stage (Gosner stage 24) exposure of *P. cruciger* in the concentration of 0.05 µg/ml 1.00 µg/ml of Mancozeb. Most of these effects synergized by anthropogenic and natural (especially predation and desiccation) stressors will contribute population declines and species extinctions of threatened amphibians. Thus the Gosner stage of the tadpole (Gosner stage 24) and the concentration of Mancozeb at exposure (0.05 µg/ml and 1.0 µg/ml) are crucial for the survival of the *P. cruciger* tadpole.

INVOLVEMENT OF ALTERED TARGET SITES AND METABOLIC ENZYMES IN ACARICIDE RESISTANCE OF THE CATTLE TICK *RHIPICEPHALUS (BOOPHILUS) MICROPLUS* FROM KURUNEGALA, SRI LANKA

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As in many other tropical and subtropical countries, ticks are common ectoparasites among wild and domestic animals of Sri Lanka. *Rhipicephalus (B.) microplus* is the most abundant cattle tick species and the most important external parasite on cattle in Sri Lanka. Usage of acaricides to control ticks has been significantly increased in the country as tick infestations cause large economic losses such as reduced milk production. Development of tick resistance to acaricides, probably due to indiscriminate usage, has been observed by cattle owners in Sri Lanka. Previously, we reported that *R. (B.) microplus*, collected from two cattle farms; Diyathure and Koulwewa, in the Kurunegala district, were 'resistant' to organochlorine DDT, 'possibly resistant' to organophosphate malathion and carbamate propoxur, and 'susceptible' to the pyrethroid permethrin (based on the resistance percentages calculated by exposing each population to different concentrations of the four acaricides). In insects and ticks, resistance to insecticides/acaricides can be developed due to increased activity of metabolic enzymes and/or altered target sites. The present study was carried out to determine the mechanisms underlying the acaricide resistance of these populations.

Adult engorged females, collected from the field, were allowed to lay eggs in the laboratory and larvae were obtained. Mechanisms of acaricide resistance were studied by conducting biochemical assays. Crude homogenates of tick larvae (225 from each population) were tested for the activity of three major acaricide metabolizing enzyme groups *i.e.* carboxylesterases (CE), glutathione S-transferases (GST) and monooxygenases. For Koulwewa tick population, Specific activities of CE and GST were 0.09 ± 0.02 and $0.38 \pm 0.06 \mu\text{mol min}^{-1} \text{mg}^{-1}$ and for Diyathure population the respective values were 0.08 ± 0.04 and $0.13 \pm 0.08 \mu\text{mol min}^{-1} \text{mg}^{-1}$. Monooxygenases were 0.14 ± 0.05 and 0.34 ± 0.18 (equivalent units of cytochrome p⁴⁵⁰) for Koulwewa and Diyathure populations respectively. However, according to previous studies, these values do not indicate any enhanced activity levels of metabolic enzymes. Organophosphate and carbamate target site acetylcholinesterase (AChE) showed a remaining activity of more than 30% in the presence of propoxur for both populations indicating that altered AChE target site is possibly responsible for organophosphate and carbamate resistance shown. Since the high DDT resistance observed could not be attributed to metabolic enzyme activities, alterations at sodium channel regulatory proteins, the target site of both DDT and pyrethroids, were tested. DNA, extracted from tick larvae, was tested for the commonly reported L925I amino acid mutation (kdr type resistance) using PCR followed by sequencing. No mutations could be detected in the samples tested. Presence of a kdr type mutation is expected due to the high DDT resistance observed in the absence of GST and monooxygenases based mechanisms. Failure to detect the mutation could be due to the limited number of samples tested. According to the results, altered AChE mechanism is the possible cause of resistance for carbamates and organophosphates in these populations.

PARTIAL CHARACTERISATION OF SERINE PROTEASE INHIBITORS FROM *SEMECARPUS NIGRO-VIRIDIS*

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Proteases, the “enzymes of digestion” participate in a plethora of physiological processes in all living organisms ranging from prokaryotes to eukaryotes. Some of these functions are release of hormones, cell growth and migration, blood coagulation, tissue arrangement, morphogenesis and reproduction. Serine protease is one of the most vital groups of proteases. Though proteases are indispensable for existence and maintenance of their host organisms, over expression of proteases can be harmful for host organisms. Hence, precise regulation of proteases and their reactions are crucial. One of the most propitious approaches in maintaining precise balance of proteases is the use of protease inhibitors. By exploiting this property protease inhibitors have been developed as promising therapeutic approaches for treating some animal diseases and as means of increasing plant resistance against pathogens. Protease inhibitors can be either proteinaceous or non-proteinaceous. Plants are a common source of protease inhibitors. Thus this study was carried out in order to detect the presence, to optimise an assay procedure to study the properties and to partially characterise protease inhibitors from *Semecarpusnigro-viridis* which is an endemic plant in Anacardiaceae family.

Serine protease inhibitory assay was conducted for aqueous bark extracts of *Semecarpusnigro-viridis*. Then the assay was optimised with respect to serine protease inhibitors which are present in aqueous bark extract. The approximate molecular weights of the inhibitors were estimated by dialysis at pH 7.6. The thermal stability of serine protease inhibitors were investigated at 37°C and 50°C over a period of one month. Anion exchange chromatography (at pH 7.6 and pH 8.5), cation exchange chromatography (at pH 5.5 and pH 7.0) and ammonium sulphate precipitation were conducted in order to partially purify the serine protease inhibitors.

Bark extracts of *Semecarpusnigro-viridis* contained serine protease inhibitors. During dialysis, serine protease inhibitory activity retained and it implied that these serine protease inhibitors were macromolecules with molecular weights greater than 8 kDa. These serine protease inhibitors exhibited a remarkable thermal stability at 37°C and even at 50°C. Furthermore this serine protease inhibitory activity which retained more or less similar to the initial activity at both different temperatures gave an indication that these inhibitors were most likely to be non-proteinaceous. The serine protease inhibitors were not sufficiently purified by either anion exchange chromatography at pH 7.6 or cation exchange chromatography at pH 7.0. However in some eluted fractions obtained from anion exchange chromatography at pH 8.5, cation exchange chromatography at pH 5.5 and only in one saturated fraction obtained from ammonium sulphate precipitation considerable yet low protease inhibitory activities were detected.

Thus, aqueous bark extracts of *Semecarpusnigro-viridis* contain a cocktail of proteinaceous and non-proteinaceous serine protease inhibitors with molecular weights greater than 8 kDa and their high thermal stability is noteworthy. Among them non-proteinaceous serine protease inhibitors exhibit a higher serine protease inhibitory activity compared to that of proteinaceous serine protease inhibitors.

**SENSITIVITY CYCLING IN PHYSICALLY-DORMANT SEEDS OF
IPOMOEA TRILOBA (CONVOLVULACEAE) AND *SIDA RHOMBIFOLIA*
(MALVACEAE):
FIRST REPORT FOR TROPICAL SPECIES AND MALVACEAE**

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Sensitivity cycling (SC) has been reported only in physically dormant (PY) seeds of temperate Fabaceae and Convolvulaceae species. However, there are large numbers of economically important species in other plant families producing seeds with PY. The aim of this study was to determine the occurrence or none occurrence of SC in seeds of two economically important tropical medicinal weeds; *Ipomoea triloba* (Convolvulaceae) and *Sida rhombifolia* (Malvaceae) collected in Peradeniya, Sri Lanka. Imbibition and germination of manually scarified and non-scarified fresh seeds were compared to confirm the PY of seeds. Effects of dry and wet storage on dormancy break and different storage treatments (dry or wet storage at 35, 25 and 15 °C) on changing sensitivity to dormancy break were evaluated. Manually scarified seeds of both species imbibed more water and germinated to higher percentage than non scarified seeds (both $p < 0.05$), confirming that the seeds have PY. However, seeds of *I. triloba* stored wet at 25 °C and those of *S. rhombifolia* stored dry at 25 °C germinated to a higher percentage only at 35 °C. These observations reveal that 25 °C wet storage and 25 °C dry storage, respectively, have made insensitive seeds of *I. triloba* and *S. rhombifolia*, sensitive to dormancy breaking treatment (35 °C wet incubation). Further, sensitive *S. rhombifolia* seeds become non dormant during 24 hours of incubation at 35 °C. Germination percentage of sensitive seeds of *I. triloba* incubated at 35 °C decreased after storage at 15 °C. Similarly, germination percentage of sensitive seeds of *S. rhombifolia* decreased after wet storage at 15 and 25 °C or after dry storage at 35 °C, showing that sensitivity of seeds can be reversed. Thus, it can be concluded that seeds of both tested plant species have SC. This is the first report of SC in tropical species and in Malvaceae. Thus, we can conclude that SC is not restricted to particular plant taxa or to a geo-climatic area but it may be found in many species producing seeds with PY.

EFFECT OF INSECTICIDE FOGGING ON NON-TARGET INSECTS DURING DENGUE MOSQUITO CONTROL PROGRAMMES

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Dengue fever and dengue hemorrhagic fever are of major public health concern in Sri Lanka. Fogging/space spraying of insecticides is frequently conducted in affected areas during dengue outbreaks to control *Aedes* vector mosquitoes. As a practice, space spraying is carried out around the patient's house/ home gardens also, once a case is detected. Since dengue mosquitoes are mostly active during the day time, fogging operations are conducted usually in mornings. Unfortunately, this is the active time for many other insects as well. There is a high possibility that insecticide fogging affects insect pollinators and other non-target insects making a huge impact on ecosystems. Objective of the present study was to determine the effect of insecticide fogging on non-target insects.

Eight fogging trials were conducted between 8.30 - 9.30 a.m. in each of two home gardens *i.e.* site 1- an open area and site 2- an area with dense vegetation, in Panaliya, Polgahawela during April 2014 - March 2015. In each trial, pesguard 161 (d-tetramethrin + cyphenothrin) insecticide was sprayed for 8 minutes using a hand-held pulse jet thermal fog generator according to the standard methodology recommended for dengue vector control, in an area of 180 m² at site 1 and 270 m² at site 2. Ten polythene sheets (each 1 x 10 m) were randomly spread on the ground covering an area of 10 m² at each fogging site 15 minutes before fogging. Thirty minutes after spraying, insects knocked down on the sheets were collected and their recoveries within 24 hours were recorded. Insects were identified using standard taxonomic keys to the order level and their body sizes were measured under a microscope using a graticular eye piece. Results were analyzed using MINITAB 14 version. A total of 3884 insects (on average 24 insects per square meter) belonging to twelve orders were collected from 10 x 2 (sites) x 8 (trials) m² of sheets. Percent recovery of insects during 24 hour was 18.86%. Diptera was the most affected (34%) insect order followed by Collembola (28%) and Thysanoptera (16%). Only 31 (< 1%) mosquitoes were found among the knock down insects and only 2 (< 0.1%) of them belonged to the genus *Aedes*. Knock-downs at site 2 were significantly higher than that of site 1. Body length of the affected insects ranged from 0.1 mm to 15 mm and 93% had body lengths within a range of 0.35 mm to 1.8 mm. WHO standard mosquito cage bioassays (n=417) and *Trigona iridipennis* cage bioassays (n=60) were carried out during fogging trials as positive controls. Initial knock downs of both mosquitoes and stingless bees were 100%. Only about 12% of mosquitoes and 6% of stingless bees recovered within 24 hours. Present study reveals that insecticide fogging has a very high adverse effect on non-target insects in the environment and frequent fogging operations can possibly reduce the abundance of insect pollinators affecting crop production. The study also shows that fogging home gardens does not successfully serve the purpose of knocking down dengue vector mosquitoes.

CHARACTERISATION OF PHYSIOLOGICAL AND GENETIC DIVERSITY OF *RHIZOBIUM* SP. IN *ALYSICARPUS VAGINALIS* IN DIFFERENT CLIMATIC ZONES OF SRI LANKA

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Legume *Rhizobium* symbiosis has been exploited in sustainable agricultural systems to improve soil fertility and quality. Hallmark trait of this symbiotic association is the ability of rhizobia to reduce the inert atmospheric nitrogen into biologically usable forms such as ammonium, nitrate and make available to the plant. Among the leguminous plants *Alysicarpus vaginalis* is an agriculturally very important clover which is used as forage, hay and cover crop in rubber plantation to control the soil erosion and to improve soil fertility. *Alysicarpus vaginalis* has the ability to involve in the symbiotic association with its compatible *Rhizobium* sp. even under the harsh environmental conditions. Characterisation of rhizobial strains which has the ability to tolerate stress conditions is an essential process in developing inoculants which can be used in agriculture to improve crop yield even under the harsh conditions. This study was conducted to characterise the rhizobial strains in *Alysicarpus vaginalis* which have ability to tolerate extreme pH, high salinity levels, high temperature and drought conditions and to assess their genetic diversity.

Root samples of *Alysicarpus vaginalis* were collected from four sites belonging to dry zone [Anuradhapura (AN) and Nikaweratiya (NW)], intermediate zone [Mawathagama (MW)] and wet zone [Peradeniya (PN)] of Sri Lanka. Rhizobial strains isolated from each site were monitored to different stress conditions. Their stress tolerance ability was checked by measuring the absorbance at 600nm in ½ Lupin broths under different pH, salinity, temperature and drought conditions. Twenty four isolates were monitored in a broad pH range (1.0-10.0), PEG concentration (0.1-0.4%); NaCl concentration (0.5-3.0%) and temperature range (25-45 °C). Genetic diversity of the stress tolerant strains were assessed by the PCR amplified ERIC profiling. All isolates were able to grow under wide pH range varying from pH 5.0-10.0 and they showed optimal growth around pH 5.0-8.0. However, all the strains isolated from MW and NW2 strain were able to grow even under the pH 4.0. Except MW3 and MW4 strains, all the other strains showed their growth at NaCl concentration varying from 0.5-3.0%. Most of the strains exhibited their highest growth at 0.5% NaCl concentration. Except MW1 and MW6, all the other isolates grew at wide temperature range varying from 25-45 °C. Their optimal temperature range was varying around 30-40 °C and most of them were able to grow even at 45 °C. Except MW1, MW4 and MW6 strains, all other strains were able to tolerate 0.1-0.4% PEG concentration range. MW1, MW4 and MW6 strains have low drought tolerance levels. Among 24 isolates, AN2, AN5, MW2, MW3, MW5, NW1, NW2, NW3, NW6, PN1, PN3 and PN6 were selected as stress tolerant strains and their genetic diversity was assessed. There were strains which belong to the same site exhibiting genetic diversity (AN2 and AN5), however some isolates gave banding patterns which indicate a genetic similarity (NW1, NW2, NW3 and NW6). Rhizobial strains isolated from four sites were diverse in their stress tolerance levels. These stress tolerant rhizobial strains can be used to cross inoculate agriculturally important legumes to improve their yield.

ANTIMICROBIAL, ANTIOXIDANT, CYTOTOXIC ACTIVITY AND PHENOLIC CONTENT OF *TETRACERA SARMENTOSA* (KOROSA WEL)**R.A.B.S. Ranasinghe¹, Y.A. Priyadarshana¹, M.D.M. Chamikara²,
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Medicinal plants play an important role in modern drug discovery. Although Sri Lanka is recognized as a biodiversity hotspot, the medicinal value of the Sri Lankan endemic flora has not been fully explored. Present study was directed towards the discovery of the bioactivity of *Tetracera sarmentosa* (Dilleniaceae) which is known as *korosa-wel* in Sinhala. Subspecies of *T. sarmentosa* are endemic to Sri Lanka and distributed in primary rain forests throughout the wet zone. Bioactivities of *T. sarmentosa* have not been reported. In this study, the antioxidant activity (using DPPH radical scavenging assay), total poly phenol content (TPC) by folincio-caltea method (expressed as the gallic acid equivalent (GAE) in milligrams per gram of dry material), Cytotoxicity by brine shrimp lethality and antimicrobial activity were assessed. Leaves and stems of *T. sarmentosa* were collected from the Seetawaka Botanic garden, Avissawella. Air dried stems and leaves were separately and sequentially extracted into dichloromethane and methanol. Bioassays were carried out for following extracts, DL (dichloromethane extract of leaves), DS (dichloromethane extract of stem), ML (methanol extract of leaves), and MS (methanol extract of stem) as three replicates for each. MS displayed the highest antioxidant activity (IC₅₀ 2.02 ppm) compared to that of α -tocopherol (IC₅₀ 13.46 ppm). IC₅₀ values of other extracts in the descending order ML < DL < DS. The TPC content of MS and ML were 41.8, 51.6 mg (GAE) /g, respectively. However, in both dichloromethane extracts of stem and leaves did not show the presence of polyphenols. DS showed highest brine shrimp lethality (LC₅₀ 1.73 ppm) compared to that of K₂Cr₂O₇ (LC₅₀ 35.78 ppm) and other extracts in the descending order DL > ML > MS. The antimicrobial susceptibility was studied against Gram negative (*Escherichia coli*), Gram positive [*Staphylococcus aureus*, methylene resistance *Staphylococcus aureus* (MRSA)], and fungi (*Candida albicans*) by disk diffusion method. ML showed the highest inhibition zone 9.66 mm against *S. aureus* compared with other extracts in the descending order MS > DL > DS. ML showed the highest inhibition zone 9.17 mm against *E. coli* and MS and DL showed inhibition zones 8.68 and 6.47 mm respectively. Among all extracts none displayed any inhibition zone against *C. albicans* and MRSA. Minimum inhibitory concentration (MIC) was determined by using the agar plate dilution method. All extracts showed lower MIC values against *C. albicans* than all bacterial strains. DL showed the MIC value 800 ppm and other extracts in the descending order DS < ML < MS. All extracts of the plant showed the MIC value 1024 ppm against *E. coli*, *S. aureus*, MRSA. This study revealed that MS and ML extracts showed strong antioxidant activities and the presence of high polyphenol contents among all extracts. DS and MS showed strong cytotoxicities. All extracts showed the significant inhibitory effect in representative Gram positive and Gram negative bacteria. According to these results, plant extracts of *T. sarmentosa* may contain compounds with a broad spectrum of antimicrobial activities. Future studies will be focused on the isolation of bioactive compounds responsible for bioactivities.

TWO SESQUITERPENES FROM *BIPOLARIS SOROKINIANA*, AN ENDOPHYTIC FUNGUS FROM *COSTUS SPECIOSUS* (KOEN.) LEAVES**M. Mallique Qader¹, N. Savitri Kumar¹, Lalith Jayasinghe^{1*}
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Discovery of the antibiotic penicillin from the fungus *Penicilliumnotatum* by Alexander Fleming in 1929 saved thousands of lives during the Second World War. With this remarkable achievement scientists paid special attention to study microorganisms as a novel source of new drug leads that benefit human beings. Several important antibiotics such as penicillin, cephalosporins, cycloporin, cholesterol lowering statins and anticancer drug taxol are of fungal origin. Endophytic fungi are the fungal microorganisms that colonize inside the plant tissues without having any effect on its host. They are a potential source of bioactive secondary metabolites which are rare and structurally diverse. *Costus speciosus* (Koen.) of the family Costaceae is a medicinal herb used as a leafy vegetable that consumed frequently as a remedy for type II diabetes. An endophytic fungus *Bipolaris sorokiniana* was isolated from triple sterilized leaves of *C. speciosus*. A pure culture of *B. sorokiniana* was inoculated to 400 ml of potato dextrose broth media (PDB) containing 1L conical flasks (x20) and incubated at room temperature (28±2 °C) for ten days and while shaking every other day. The medium was filtered after four weeks, and the filtrate was extracted to ethyl acetate (EtOAc). The residual mycelium was extracted into EtOAc using sonicator. The two EtOAc extracts were found to be similar by TLC analysis. EtOAc extracts were screened for antifungal (against *Cladosporium cladosporioides*), antioxidant (DPPH), brine shrimp lethality (against *Artemia salina*), lettuce seed germination (against *Lactuca sativa*) and α -amylase enzyme inhibitory bioassays. The extract was found to be active for all bioassays. Chromatographic separation of EtOAc crude extracts over silica gel, sephadex LH-20 and preparative thin layer chromatography furnished, highly UV active (254 nm) compounds helminthosporal acid (**1**), helminthosporol (**2**) and ergosterol by detail analysis of ¹H, ¹³C NMR and FABMS spectral data. Compounds **1** and **2** were found to be significantly toxic to brine shrimps, while compound **1** showed activity against *C. cladosporioides*. This is the first report on isolation of *B. sorokiniana* from *C. speciosus* and production of a rare sesquiterpene helminthosporal acid from *B. sorokiniana*.

EFFECT OF DIFFERENT DISTURBANCE REGIMES ON POLLINATOR AND NON-POLLINATOR FIG-WASP RELATIONSHIPS AND SYCONIAL CHARACTERS OF *FICUS EXASPERATA* VAHL (MORACEAE) IN KANDY DISTRICT, SRI LANKA

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Reproduction of partners, figs and their pollinating fig-wasps of species specific fig/fig-wasp obligatory mutualistic system are closely dependent on each other. Role of non-pollinator fig-wasps of the fig/fig-wasp system is also important due to negative impacts of them on fig-wasp mutualism. *Ficus exasperata* Vahl (Moraceae) is a gynodioecious fig species and its pollinator fig-wasp species is *Kradibia gestroi* (Hymenoptera: Agaonidae: Agaoninae). This study was carried out from January 2012 to December 2013. After pre-visits to the sites and using satellite images highly disturbed urban core of Kandy Municipal Council Area (KM), moderately disturbed Park of University of Peradeniya (UP) and a less disturbed traditional village setting in Tumpane/Hataraliyadda DS area (TP) were selected to investigate the effect of different disturbance regimes on pollinator/non-pollinator fig-wasp relationships and the syconial characters of *F. exasperata*. GPS locations of *Ficus exasperata* trees within 1 km radius area were recorded. Mature syconia were picked randomly; length and diameter of syconia were measured, cut into two equal halves and kept in laboratory to rear the wasps. Florets of syconia halves and pollinator and non-pollinator fig-wasps emerged were sexed and counted. Percentage emergence of wasps was highest in the syconia from TP (95.83%). Syconial length (LS), syconial diameter (DS), syconial volume (VS) and number of florets per syconia (FI/S) of three sites were significantly different ($P < 0.05$) and mean values of all characters were recorded highest in TP (LS=18.96±1.24mm, DS=18.09±1.42mm, VS=3371.8±674.3mm³, FI/S=716.6±225.0). Total fig-wasps per syconium (TFW), pollinator fig-wasp males (PFWM), non-pollinator fig-wasp females (NPFWF), non-pollinator fig-wasp males (NPFWM) and fig-wasp sex ratios were significantly different ($P < 0.05$) among the three sampling sites. Mean TFW (248.0±138.3) and pollinator fig-wasp females (148.6±108.4) and PFWM (92.93±61.33) were highest in TP site. However, NPFWF (18.85±9.86) and NPFWM (15.12±7.36) were highest in KM site. Mean number of both males and females of pollinator fig-wasps per syconium was higher in TP than in others and the mean number of both males and females of non-pollinator fig-wasps per syconium were higher in KM than in others. Accordingly, less disturbed non-urbanized TP site harbours more pollinators; whereas, highly disturbed urban KM site harbours more non-pollinators. Reduction of pollinators results in reduced seed production adversely affecting long term existence of both fig and the fig-wasps. Fig-wasp sex ratios were significantly different ($P < 0.05$) among sites and sex ratios were female biased. The study reveals that the disturbance to vegetation negatively affects the syconial characters, pollinator/non-pollinator relationships and overall fig/fig-wasp system of *F.exasperata*.

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COMPARISON OF LITTER ARTHROPOD DIVERSITY AND ASSEMBLAGES BETWEEN TWO VEGETATION TYPES IN UPPER HANTHANA FOREST RESERVE, SRI LANKA

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Litter ants and other arthropod play a significant role as ecosystem engineers and represent a major part of the terrestrial biodiversity. Despite the importance, their diversity is poorly acknowledged. This study compares the diversity and assemblages of litter ants and other arthropod in two different vegetation types; secondary forest and pine plantation in Upper Hanthana forest reserve between 700 – 800 m altitudes.

They were sampled along three 100 m transects laid in the two sites. Along the two sites of each transect, 1 m² plots were demarcated at 20 m intervals. Plots in one side were used to sample litter arthropod by Winkler extraction method while the litter arthropod in plots were handpicked on the other side. Along each transect, six pitfall traps were laid out 2m apart from each plot. In each plot, physical parameters (temperature, humidity, light intensity) and litter structure variables (bare grounds, leaf litter, large rocks, plant stems, the number of dead branches and fallen tree trunks) were measured from December 2013 to June 2014. All specimens were identified into different morpho-species. Statistical analysis was done using MINITAB 14 and PRIMER version 6 Software.

Sampling yielded 3488 litter arthropod in 23 orders representing 88 morpho-species. In both sites, ants were the most common. Altogether, seven subfamilies; Cerapachyinae (1 genus and 1 species), Dolichoderinae (3, 5), Formicinae (3, 3), Leptanillinae (1, 1), Myrmicinae (12, 16), Ponerinae (6, 8) and Pseudomyrmicinae (1, 1) were recorded. Subfamily Myrmicinae included the highest number of species (15). Pheidole was the most diverse genus (4 species) and *Solenopsis* sp.1 was the most abundant (639) species. Diversity of litter ants and other arthropod between the two sites showed a significant difference (<0.05). ANOSIM test confirmed with 12% similarity revealed that there was a significant difference in species diversity between the two vegetation types. Shannon and Berger Parker indices showed high diversity in secondary forest while Simpson's evenness and Shannon evenness indices indicated high level of evenness in pine plantation than secondary forest. Species accumulation curves from three collection methods did not reach a plateau indicating that sampling effort was not enough to collect all the different types of litter arthropod in the study. Results of BIOENV procedure in PRIMER indicated that there was a positive relationship between species diversity and litter structure variables in secondary forest. Among weather parameters both temperature and humidity affected the species diversity in secondary forest while only temperature was affected in pine plantation. In addition there was a positive correlation between ants and other arthropod diversity.

Final result of high species diversity in the secondary forest shows the importance of natural forests which provide high habitat heterogeneity than plantations. Resulting correlation between litter ants and other arthropod highlight the high possibility of the use of ants as a diversity indicator.

LIFE CYCLE OF *NOSOMMA MONSTROSUM* UNDER LABORATORY CONDITIONS

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Nosomma monstrosum is a monotypic, two or three-host hard tick (Ixodidae) with a limited geographic distribution in India, Pakistan, Sri Lanka and Indochina. In Sri Lanka, it is confined to dry zone forests infesting cattle and buffalo. The present study describes the biological data on the life cycle pattern of Sri Lankan population of *N. monstrosum* collected, using experimental infestation on New Zealand white rabbits under laboratory conditions (Temperature 27±1 °C; Relative Humidity 70% - 80%). Engorged females (n=38) were collected from buffaloes from Polonnaruwa district to establish a laboratory colony. Eggs laid by the females were incubated until hatched and randomly selected larvae (270), and thereafter nymphs (48) and females (12) were fed on rabbits. Once the engorged larvae and nymphs dropped off, they were allowed to moult. Weight and length measurements were taken for each life stage before and after feeding. Then the eggs laid by the laboratory hatched females were collected and incubated and a second generation colony was started. All three stages: larva, nymphs and adults successfully fed on rabbits and dropped off before moulting. This shows the *N. monstrosum* population in Sri Lanka has a three-host life cycle which took 64 -102 days to complete. The tick can complete three generations during a year under experimental conditions. However, we cannot extrapolate this to a natural context uncritically because; the chances of finding three consecutive hosts in the natural habitat are less. Of the wild females collected from buffaloes, those weighed less than 29 mg did not oviposit but those that were over 29 mg laid 199-1,565 eggs. Females of the second generation laid a higher number of eggs (3,864 – 12,520). There was a high positive correlation between the number of eggs and the female weight (Pearson Correlation $r=0.906$, $p<0.001$). The Reproductive Efficiency Index (REI; Number of eggs per mg of female weight) and percent eclosion (percentage of hatched eggs with respect to the total number of eggs laid by each female) were 9.8±3.9 and 46.6±35.4, respectively. The first generation females had a significantly lower REI than the second generation females (REI: 20.3±4.4; $F=16.26$; $P=0.001$). The REI depends on the number of eggs laid and the weight of the female. Since all the females of the second generation were allowed maximum engorgement, they laid a higher number of eggs than the first generation females caught from wild. The larval incubation took 14-30 days. Feeding periods took 2-4 days for larvae and nymph whereas 7-8 days for females. Larvae and nymphs took 8-11 and 15-18 days for moulting, respectively. Percent attachments to the host body were 81.5±9.2, 77.8±29.6 and 66.7±57.7 for larva, nymph and female, respectively. The male: female sex ratio was 8:3 in laboratory raised adults. A higher ratio of males was observed in the field collection as well. The pre-oviposition period was 4-5 days followed by an oviposition period of 11-17 days and females died in 1-5 days after oviposition. Results show that Sri Lankan population of *N. monstrosum* has a three-host life cycle and there are differences in the life cycle pattern when compared to Indian population, which has either a two-host cycle or a three-host life cycle. The number of hosts in a life cycle of a tick is important in describing disease dynamics of infectious agents they carry.

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CALL REPERTOIRE OF *PSEUDOPHILAUTUS VIRIDIS* (ANURA: RHACOPHORIDAE): AN ENDEMIC SHRUB-FROG OF SRI LANKA

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South Asia is a region of high endemic anuran diversity. Despite the endemism, very little is known about the vocalization of these anurans. New anuran species, especially that of shrub frogs (*Pseudophilautus*) are being described at a rapid pace in Sri Lanka. Due to high levels of polymorphism or crypsis, these new species descriptions are often based on multiple criteria such as morphology, morphometrics, genetic data and in a very few instances basic bioacoustic data. Given the high diversity, crypsis and polymorphism, bioacoustics can be used for rapid and accurate species identification in the field, facilitating species-conservation and population monitoring. We provide a detailed acoustical and statistical description of *Pseudophilautus viridis* by analyzing their commonly produced call types. *Pseudophilautus viridis* is an endemic Sri Lankan shrub frog restricted to the Central Hills above 800m a.s.l. A total of 20 Calls from each of 20 male frogs were recorded from a population in Fishing Hut (6.833 N, 80.570 E). Following each recording the male was captured and its Snout Vent Length (SVL), body mass and wet bulb air temperature at the male's calling site were measured. Acoustic recordings were analyzed using Raven v1.3 software. Descriptive statistics of call properties and Pearson product moment correlations between call properties were calculated. Males of *P. viridis* produced a single call type consisting of only a single pulse. The typical call lasted for 7.8 ms. Call groups had calls between 2-11 calls per call group. The calls were produced at a rate of 2-3 calls/s. The power spectrum of call was characterized by a single frequency peak at about 2.48 kHz. Wet bulb air temperature was correlated with inter-call interval, call period and dominant frequency. Call peak power was positively correlated with male's SVL and index of body condition. None of the call properties were significantly correlated with the body mass. Pattern of individual variation in call properties were consistent with descriptions of the few other South Asian Rhacophorids. Dominant frequency had a higher variation among individuals compared with within individuals. Therefore Call properties which are related to conservation would be important for future studies. The single call type described here is possibly the advertisement call of *P. viridis*.

INSECT COLONIZATION AND SUCCESSION IN DECAYING CARCASSES PLACED IN SELECTED SITES OF THE PERADENIYA UNIVERSITY PARK

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Insects have been used as an important tool in forensic investigations to determine time of death to draw conclusions in legal cases relating to both humans and wildlife. There is a single study conducted in 1995 in Sri Lanka to investigate insect colonization and succession in decaying rabbit carcasses. In this work insect colonization and succession in decaying seven mammalian and one fish carcasses were studied to determine the insect groups associated with different decaying stages, their colonization at different stages of decay, and to identify the common insect species, which can have a potential use in Post Mortem Interval investigations. Mammalian carcasses for the study were obtained from Veterinary teaching hospital, University of Peradeniya. Fish carcass was bought from public market, Kandy. The study was conducted from January to June 2014, in Hanthana forest (one dog, two lab rats, one palm civet and a barking deer carcass), faculty premises (a common squirrel and fish carcasses) and in a home garden in Gampola (one dog carcass). Insects visiting carcasses during different decomposition stages such as fresh, bloated, active decay, post decay and skeletal stages were observed and counted. Species and the number of insects visiting each carcass were recorded daily during day time, from 10.00 a.m. to 12.00 noon when most insects are active. Three random counts were made giving 15 minutes interval to reduce double counting and average values were taken for further analysis. Only representative samples of observed insects were collected and preserved in 70% ethanol for identification to the most possible taxon. Temperature and relative humidity of the sites were measured throughout the study period. A total of 1, 267 adult arthropods belonging to five orders, 21 families and 31 morpho species were recorded from all carcasses. Diptera and Coleoptera were encountered frequently with 13 and four families, respectively. The three fly families; Sarcophagidae, Calliphoridae and Muscidae were the most dominant. Among 588 adult flies recorded, 191 individuals belonged to two species of sarcophagids of which *Sarcophaga* sp. being the most common. The first insect to colonize six out of eight carcasses was *Sarcophaga*. *Calliphora* sp. (Calliphoridae) was also recorded as a frequent visitor. Four different genera of Muscidae were recorded as the most common groups. Among the 93 adult beetles, 36 individuals belonged to three species of staphylinids and 27 belonged to two species of scarabaeids were the most predominant families while 14 individuals of two species of Histeridae were the least. Sixteen individuals of the parasitoid wasp, *Brachymeria* sp. were encountered as the natural enemy of dipterans that damaged pupae and destroying the evidences of insect succession. Of the two lab rats placed in two different habitats in Hanthana area between 500-600 m altitude, the highest insect diversity was found in secondary forest ($H' = 0.6736$) compared to that of in pinus plantation ($H' = 0.6336$). Insect succession in the five major decomposition stages of carcasses revealed that dipterans are the early colonizers in decaying carcasses at fresh, bloated and active decay stages while the coleopterans visited later stages, especially at post decay and skeletal stages. Present study highlights the importance of *Sarcophaga* sp., being the first colonizer of six out of seven carcasses, in future forensic investigations in the country.

CHARACTERIZATION OF SOL-GEL SPIN COATED NANOCRYSTALLINE CADMIUM SULPHIDE THIN FILMS

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Present studies of CdS are carried out due to its potential applications in solar cells, electronic devices, nano devices and other optical devices. Nanostructures have received a great attention in recent years because of their distinctive chemical, physical, optical, electrical and transport properties which are different from those of either the bulk materials or single atoms.

Nanocrystallinecadmium sulphide (CdS) thin films were prepared with cadmium nitrate as cadmium source and thiourea as sulfur source. For preparation of CdS sols polyethylene glycol (PEG) was used as the binder, ethanol was used as the solvent and as a catalyst to the reaction acetic acid was used. Among various methods available for thin film preparation, sol-gel spin coating technique was used to deposit CdS thin films due to its simplicity, low cost and its ability to obtain uniform films with good adherence and reproducibility in a relatively shorter processing time at lower temperatures.

The effect of spin coating speed and annealing temperature on structural and optical properties was studied by X-ray diffraction (XRD) and UV-VIS Spectroscopy. The XRD study of CdS thin films confirmed the formation of CdS nanostructures with particle sizeranging from3.31nm to 10.85nm. The effect of annealing temperature clearly influenced the particle size resulting increase in particle size with increasing temperature. Further, structural analysis showed that crystallinity and grain size increases with thickness whereas strain and dislocation density decreases. All of the CdS films have crystalline in nature and showed a preferential orientation along (0 0 2) with hexagonal phase structure. The Optical studies revealed the quantum confinement effect in the thin films because of the small sizes of the particles and hence raised the optical band gap than that of the bulk material.

SYNTHESIS OF A METALLATED PORPHYRIN COMPLEX USING FERROUS SULFATE AND INVESTIGATING ITS CHARACTERISTICS

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Porphyrins are widely researched due to their unique ability of serving in several ways such as a metal binder (ligands), as a solar cell (convert light or chemical energy), as an oxygen transport medium (hemoglobin), and as an electron transfer medium (conducting polymers), Gene regulation, Drug metabolism, Iron metabolism and hormone synthesis. Properties of porphyrins could be widely altered by attaching different functional groups externally as well as into its center. Many complexes with different properties could be achieved by changing the metal iron in the center of the porphyrin ring. The aim of this study is to investigate the characteristics of porphyrin ring that is metallated with ferrous sulfate. Ferrous sulfate is used as the metal resource that can be incorporated into porphyrin ring. Fe²⁺ ions binds into freshly prepared porphyrin ring as the ring is produced. This is the first recorded attempt of intercalating a metal into porphyrin ring during the process of porphyrin ring preparation.

Metallated porphyrins were prepared using a mixture of Benzaldehyde, Propionic acid, Nitrobenzene and Pyrrole and Ferrous sulfate is added to the same mixture. Reaction mixture is then heated to a temperature of 120°C in a refluxing apparatus until the desired complex is obtained. Required purification is done in a similar manner. Characterization is done using Fourier transform infrared spectroscopy (FTIR), Cyclic Voltammetry and UV-Visible spectroscopy. All these analytical methods confirmed that Fe²⁺ intercalated porphyrins exhibits improved properties than bare porphyrins. Cyclic voltograms confirmed the reducing ability of these complexes. UV-visible and FTIR spectra of these complexes confirmed the formation of bare porphyrins and the Fe (II)-Porphyrin complexes. Furthermore, cyclic voltammetry measurements confirmed the potential usage of metallated porphyrins as reducing agents or as catalysts, therefore, metallated porphyrin complexes are of great characteristics and could be incorporated into many devices in order to enhance the desired performance.

**ANTI-FUNGAL ACTIVITY AND ISOLATION OF A KAURANE
DITERPENOID FROM ROOT EXTRACT OF *AUSTROEUPATORIUM
INULIFOLIUM* (KUNTH) KING & ROBINSON**

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Plants are a rich source of natural bioactive products such as alkaloids, tannins, terpenoids and flavonoids, where some of these reported to have shown *in vitro* antifungal properties. The plant *Austro eupatorium inulifolium* is an aggressive invader that rapidly colonizes in Knuckles, Sri Lanka. Previous work has shown that the plant parts contain potent, antioxidant, cytotoxic and phytotoxic activity. This study is carried out to investigate the antifungal activity of root extract of *A. inulifolium*. The dichloromethane root extract was fractionated using Medium Pressure Liquid Chromatography (MPLC) and further separation of active fractions was carried out using a flash chromatography. A solvent gradient of increasing polarity (n-hexane, CH₂Cl₂ and methanol) was incorporated. Thin layer chromatography was used to separate different compounds in fractions and the components were identified by specific R_f (Retention factor) values of anisaldehyde sprayed spots. With the aid of *Cladosporium* bio assay, activities of the components against *Cladosporium cladosporioides* were studied. The presence of antifungal compounds was detected by inhibition zones. Finally, the R_f values of the inhibition zones were measured and compared with R_f values of anisaldehyde sprayed spots. The isolated compound from the root extract was confirmed by ¹H and ¹³C NMR (solvent: CDCl₃) and compared with data from literature. Antifungal compounds were eluted in a range from 20% CH₂Cl₂ in n-hexane to 3% methanol in CH₂Cl₂. Root dichloromethane extract of *A. inulifolium* possess highly active antifungal compounds against *Cladosporium cladosporioides*. Most of the components in the extract are terpenoids, possibly kaurane diterpene derivatives and labdane diterpenoids. One such isolated compound was determined to be ruilopeziol which is a kaurane diterpene derivative. The isolated diterpenoid is not an antifungal compound. An antifungal compound showed a closer R_f value to isolated diterpenoid. The presence of these antifungal compounds may consider as an important determinant of the plant's invasion success in their introduced habitats.

A NEW HETEROCYCLIC COMPOUND FROM THE REACTION OF 9-METHYL-4,7-DIOXODODECAHOIC ACID WITH HYDRAZINE

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Nitrogen containing heterocyclic compounds find many applications in the pharmaceutical industry. Here, we report the synthesis and characterization of a new N-heterocyclic compound by the reaction of 9-methyl-4,7-dioxododecanoic acid (**1**) and hydrazine (**2**) in aqueous ethanol. To the best of our knowledge the reported compound 1,9-diaza-5,9-didehydro-8-(2-methylpropyl)-bicyclo[3.3.1]nonan-2-one (**3**) contains a previously unreported ring system. The structure of the compound was assigned on the basis of its GS-MS, ¹³C, ¹H, COSY, HSQC, HMBC NMR and IR spectra. Reaction of 9-methyl-4,7-dioxododecanoic with hydrazine is shown in Figure 1.

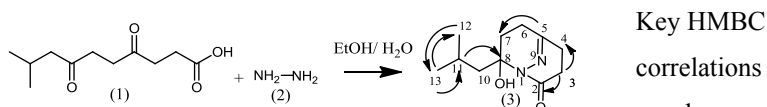


Figure 1: Reaction of 9-methyl-4,7-dioxododecanoic acid and hydrazine

The GC-MS showed a single peak on the chromatogram with a base peak at m/z 192 which corresponds to $[M-H_2O]^+$ ion. The ¹³C NMR showed 11 signals indicating that all 11 carbons of the starting compound were incorporated in the product. Atoms C11 and C12 gave rise to two separate signals at δ 22.60 and δ 21.95. This assignment is supported by the presence of two doublets centered at δ 0.895 and δ 0.865 which integrate for 3 H each in the ¹H NMR spectra. The nonequivalence of the methyl groups arises due to the isobutyl group being attached to the asymmetric carbon C8 which occurred at δ 83.05. The observed chemical shift of the methylene carbon of the isobutyl group δ 46.38 was within the calculated range. The carbonyl carbon C2 was seen at δ 170.55 and the carbon double bonded to N C3 at δ 159.65. The two CH₂-CH₂ fragments fell into two isolated ABXY systems and their respective protons gave rise to separate signals due to being incorporated into a conformationally rigid system with restricted free rotation. These H signals were in the range of δ 1.5 – δ 2.8. Computational studies were carried out to assess the stability of the molecule. First the molecule was built using a molecular modeling software package and optimized using PM6semi-empirical level of theory. The optimized structure was used as the input for conformational analysis. Conformational analysis was carried out with MMFF94s classical force field (FF) in the gas phase. The study showed that **3** is a stable molecule and has as its most stable conformation that shown in Figure 2.

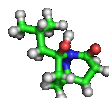


Figure 2: Most stable conformer of 1,9-diaza-5,9-didehydro-8-(2-methylpropyl)-bicyclo[3.3.1]nonan-2-one

DEVELOPMENT OF A PAPER-BASED ELECTROCHEMICAL DEVICE FOR THE SIMULTANEOUS DETECTION OF CADMIUM AND COPPER

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Use of paper-based analytical devices for the detection of environmental pollutants is becoming popular due to the low cost, simplicity, and requirement of small amounts of reagents. In addition to these advantages, capabilities of onsite determination make the paper-based devices highly useful in environmental analysis. Electrochemical detection of analytes adds many benefits such as sensitivity and selectivity with the use of appropriate electrode materials to the paper-based tools. In the present study Cu and Cd in water samples were successfully determined simultaneously. Simultaneous determination is advantageous as it reduces the sample analysis time significantly too. Also cyclic voltammetry-based detection of two or more metals using paper-based devices is not reported previously.

A chromatographic paper fabricated with commercially available varnish paint was used as the paper-based platform for the device. A horizontal micro-channel developed on the paper was used to separate Cu and Cd metal ions. One end of this micro-channel was used to develop the electrochemical detector and the other end was used to introduce the sample and the mobile phase. Working, counter and reference electrodes were developed using phenol formaldehyde-modified carbon paste, graphite and conductive silver paint, respectively. The separation of the targeted metals, Cu and Cd, was carried out using the micro-channel after introducing the sample with the help of a mixture of acetone and diluted HCl. A series of Cu and Cd standard solutions were used to test the device. Detection was performed using continuous multiple cycles of cyclic voltammograms, and the peak currents at different cycles were used to quantify the levels of Cd and Cu. Observed peak currents showed a linear relationship with metal ion concentrations. Proposed simultaneous detection method can be successfully used to detect both Cu and Cd in water. Similar tools can be developed for the simultaneous detections of various other redox active pollutants in waste water.

PESTALOTIN AND HYDROXYPESTALOTIN FROM AN ENDOPHYTIC FUNGUS ISOLATED FROM *MANILKARA ZAPOTA* FRUITS

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Endophytic fungi are considered as an outstanding source of bioactive natural products since they occupy unique biological characteristic as they grow in so many unusual environments. In a continuation of our studies towards the search for bioactive compounds from Sri Lankan flora we investigated the secondary metabolites produced by an endophytic fungus isolated from the fruits of *Manilkara zapota* of the family Sapotaceae. Endophytic fungus was isolated from the inner part of triple sterilized fruits of *M. zapota*. Large scale culturing was carried out by transferring pure culture grown on PDA medium to 1L conical flasks (×20) containing 400ml of PDB medium, which were allowed to stand at room temperature for ten days, and then incubated while shaking every other day on a laboratory shaker. The fermentation medium was filtered after one month and the filtrate was partitioned with EtOAc. Concentration of the EtOAc layer on a rotary evaporator furnished EtOAc extract. Residual mycelium was extracted with EtOAc using sonicator. TLC analysis indicated that the EtOAc extract from the PDB medium exhibited the same pattern of spots as that from the mycelium. Extracts were screened for antioxidant activity using DPPH assay, α -amylase inhibition activity, antifungal activity against *Cladosporium cladosporioides*, phytotoxicity by lettuce seed germination assay, brine-shrimp toxicity against *Artemia salina* and anticandidal activity against five different candidal species *C. albicans*, *C. glabrata*, *C. krusei*, *C. parapsilosis* and *C. tropicalis*. Hence, the two EtOAc extracts were combined and chromatographed over silica gel (*n*-hexane-EtOAc-MeOH), Sephadex LH-20 (MeOH) and PTLC to furnish compounds **1** and **2**, which were identified as pestalotin and hydroxypestalotin by detail analysis of NMR and MS data. Identification of fungal species and determination of bioactivities of pure compounds are in progress.

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AN ASSESSMENT OF ANTIBIOTIC RESISTANCE IN BACTERIA ISOLATED FROM POULTRY MANURE AND MANURE AMENDED SOILS IN KANDY DISTRICT, SRI LANKA

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As antibiotic resistant gut flora and nearly 3 to 60 % of antimicrobials used in feed could end up in poultry litter, poultry manure could serve as a source of antibiotic resistance determinants to the environment. A study was conducted to assess the abundance of antibiotic resistant bacteria (ARB) in poultry litter and manure, and agricultural soils, and to characterize selected bacterial isolates. Sampling was performed in WM3 agro-ecological region in Kandy district, Sri Lanka. Soil from thirteen cultivated fields with the history of poultry manure application and two fields with natural vegetation were sampled at 0-10 cm depth. Broiler manure were sampled from five manure heaps at agricultural fields and litter samples (bedding materials) were collected from four medium scale layer farms in the study area. Soil and poultry manure samples were analyzed for pH, electrical conductivity, respiration, potentially mineralizable N (PMN), active C and total culturable bacteria. Bacteria were enumerated using 0.3% tryptic soy agar supplemented with tetracycline or enrofloxacin each at 0, 1 and 10 ppm in spread plate technique. Fourteen isolates were selected and characterized for gram staining, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) for tetracycline. Multiple antimicrobial resistances of isolates towards tetracycline, enrofloxacin and neomycin were evaluated by antibiotic susceptibility test using disk diffusion technique.

Culturable bacteria populations for uncultivated soil, cultivated soil, broiler manure and layer litter were 7.25 ± 0.77 , 6.96 ± 0.34 , 7.14 ± 0.31 , and $7.42 \pm 0.38 \log_{10}$ CFU/g respectively. Total culturable bacteria populations significantly correlated with active C and PMN of the soil and manure. In soils bacteria resistant towards tetracycline and enrofloxacin at 10 ppm ranged from 3.58 to 4.99 \log_{10} CFU/g and 0.96 to 2.55 \log_{10} CFU/g respectively. Bacteria resistant to tetracycline and enrofloxacin at 10 ppm ranged from 4.66 to 5.52 \log_{10} CFU/g and 0.62 to 2.67 \log_{10} CFU/g. Abundance of bacteria resistant towards tetracycline was higher than enrofloxacin in all samples. The degree of suppression of bacteria population with increasing antibiotic concentration was highest in the uncultivated soils than other soil and manure samples. The abundance of tetracycline resistant populations at 1 and 10 ppm concentrations were significantly higher in layer litter (6.37 ± 0.18 and $5.45 \pm 0.07 \log_{10}$ CFU/g respectively) compared to all other soil, manure and litter samples. Abundance of ARB populations in all samples declined with increasing antibiotic concentration in the growth medium ($r = -0.63$). The MIC and MBC of the isolates ranged from 16-128 mg/L and 512-1024 mg/L, respectively. One isolate out of 14 was resistant to tetracycline (30 μ g), enrofloxacin (5 μ g), and neomycin (30 μ g). Poultry manure, layer litter and soil collected from WM3 agro-ecological region in Kandy district harbor bacteria resistant to tetracycline and/or enrofloxacin. Variability in tetracycline and enrofloxacin resistance characters is suggestive of high diversity among ARB.

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MICROHABITAT AFFINITIES OF MURINE RODENTS (RATS AND MICE) INHABITING GRASSLAND HABITATS IN PERADENIYA UNIVERSITY PREMISES

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Ecological studies have demonstrated that distribution of small mammals is strongly associated with availability of suitable microhabitats within a given habitat, especially nesting and foraging sites. Studies on their microhabitat use are essential to understand their distribution and abundance. This study recorded microhabitat affinities of murine rodents frequenting grasslands in the university premises. Rodents were sampled using locally made mesh traps in four grassy patches; Site 1: (07.26°N, 80.60°E; 534m) near Science Education Resource Center, Site 2: (07.25°N, 80.60°E; 539m) near Ivor Jennings hall, Site 3: (7.25°N, 80.59°E; 476m) near Akbar Bridge and site 4: (7.23°N, 80.61°E; 593m) near Galbantalawa. A total of 40 mesh traps were placed overnight in each site for four consecutive days in each month for four months. Twenty descriptive microhabitat variables were taken for each trapping spot. Principal component analysis (PCA) was used to analyze microhabitat data statistically. A total of 64 rodents were collected from the four sites: *Mus fernandoni*(14), *Mus cervicolor*(17), *Rattus rattus*(26), *Bandicota indica*(06) and *Golunda ellioti*(01). PCA resulted in 7 axes, which explained 74.2% of the total variance in microhabitat variables. The first three components in the factor analysis explained 43.0% of total variance in microhabitat variables. PC1 represented a gradient of areas with herbaceous species to areas with fallen logs. PC3 represented a gradient of high number of shrub species and high litter cover to high soil exposure and high overstory and understory tree size. Nine microhabitat variables: height of grass, number of grass bushes, understory tree dispersion, number of woody species, distance to rock, number of grass species, herbaceous stem density, distance to water, short herbaceous stem density did not have loadings over 0.5 on any of the first three components. *Bandicotaindica*, *M. cervicolor*, *M. fernandoni*, *G. ellioti* utilize more or less the same microhabitats with high number of herbaceous species and less fallen logs. *Rattusrattus* while sharing the above microhabitats, extend their distribution to areas with fallen logs and less number of herbaceous species. *Bandicotaindica* frequent places with moderate number of shrub species, litter cover and soil surface exposure compared to other species. *Musfernandoni* do not extend microhabitats to areas with high soil exposure, less litter cover and less number of shrub species. The microhabitat utilizations of small mammals in the four sites changed according to available microhabitats. In site 1, *M. fernandoni* frequent areas with herbaceous stems, rocks and grasses than *M. cervicolor*. In site 2, *B. indicafrequent* areas with litter cover and herbaceous species. In site 3 *M. cervicolor* frequent areas with litter cover and less number of woody species. In site 4, *R. rattus* frequent areas with less litter cover and less number of rocks. *Golundaellioti* was recorded only from site 3, which was surrounded by a secondary forest habitat with a small coffee plantation. *Bandicotaindica* are restricted to a very small microhabitat range compared to other four species. Similar microhabitat affinities for *R. rattus* are reported from Hantana secondary forest but outside Sri Lanka they are reported to prefer microhabitats with a deep cover of leaf litter and dense understory with numerous vertical stems. In forest habitats *B. indica* are reported to prefer relatively open areas with tree stumps and herbaceous plants. Microhabitat utilization of *M. fernandoni*, *M. cervicolor* and *G. ellioti* is reported here for the first time. *R. rattus* is more or less a generalist whereas the other four species are microhabitat specialists preferring a clearly defined range of microhabitats more or less overlapping with each other.

**MOLECULAR AND MORPHOMETRIC CHARACTERIZATION OF
PARABRONEMA SPP. IN ASIAN WILD ELEPHANT (*ELEPHAS
MAXIMUS MAXIMUS*) IN UDAWALAWE NATIONAL PARK
IN SRI LANKA**

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Sri Lanka is a home to several endangered species of mammals including Asian elephants. Currently, Sri Lankan wild elephants face many challenges to survive and researchers have identified gastrointestinal parasites as one of the major threats to their livelihood. Previous postmortem findings suggest that *Parabronema* spp are causing severe stomach ulcers in wild elephant population in Sri Lanka. However, there were no data available on taxonomy of *Parabronema* species in Sri Lanka. Therefore, the present study was carried out to study the morphological and molecular taxonomy of *Parabronema* spp. in wild elephants for the first time in Sri Lanka. Adult worms were collected from the stomach ulcers at the postmortem of wild elephants during the period of December 2013 to December 2014 at the Udawalwa National Park. The worms were embedded in the cavities of stomach nodules. Fifteen worms (7 males and 8 females) were used to investigate fifteen morphological characters using Commonwealth Institute of Helminthology (CIH) keys. According to that, this parasite was identified as a nematode belonging to the genus *Parabronema*.

The body of this parasite is slender and tapering, consisted with transversely striated cuticle. The mean body lengths of adult female and male worms were 7.12±0.51mm and 5.20±0.3mm respectively. The oral cavities of worms were boarded with paired lateral lips. The cuticle of the head was thick and it folds forming six horseshoe shape cordons with a straight posterior margin surrounding the head. A cuticular tube opens in to the esophagus with cephalic and caudal portions lengthening 1.6±0.10mm and 1.50±0.10mm in female and male respectively. Male worm has convoluted testis and a spirally coiled tail end bearing two unequal spicules (0.25±0.01 mm and 0.42±0.01mm) and 6 pairs of pre and post cloacal papillae. Genital organs of female consist with two uteri bearing large number of embryos. The vulval opening is located 0.13±0.02mm anterior to the posterior end of the esophagus. According to our findings, this species holds significant differences with some similarities to the previously described *Parabronema* spp. DNA extracted from worms was subjected to PCR. ITS-2 region and portion of 28S gene were amplified separately using universal primers. DNA sequence lengths obtained for samples were 306, 271 and 184 bp for ITS-2 and 1075, 1164 and 1123 bp for 28S region respectively. NCBI Blast search revealed that ITS-2 sequence has 85% similarity to *P. skrjabini*. However, 28S DNA sequences of *Parabronema* sp were not available for the comparison. Our studies revealed this nematode belongs to the genus *Parabronema*. However, further investigation should be carried out to determine the species.

IS MCPA A BETTER HERBICIDE? EFFECT OF MCPA ON TADPOLES OF COMMON HOURGLASS TREE FROG *POLYPEDATES CRUCIGER* UNDER LABORATORY CONDITIONS

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MCPA (4-Chloro-2-methylphenoxyacetic acid) is a selective herbicide that is used to control annual broad-leaf weeds in rice paddy cultivations in Sri Lanka. This herbicide is used widely and its use was further increased after glyphosate was banned following the controversial hypothesis that CKDu is associated with glyphosate toxicity. Glyphosate is known for its high toxicity to amphibians, even at very low concentrations. A 16-day static renewal experiment was used to test the direct toxic effects of MCPA, on the survival and development of tadpoles of common hourglass tree frog, *Polypedates cruciger*. Ten-day post hatch tadpoles (Gosner 25) from three nests were exposed to a concentration series of MCPA (0.01, 1, 2 and 10 ppm) in glass tanks containing 2 L of pesticide solutions prepared using aged tap water (20 tadpoles per tank). All the treatments and controls were maintained in triplicate. Medium in the tanks was renewed once every four days. Tanks were monitored daily for mortality. Size of tadpoles (total length and body mass) was measured at the beginning, 8th day and 16th day of the experiment. To determine 48 hour LC₅₀, tadpoles were exposed to a concentration series of MCPA (500, 800, 900, 1000, 1200, 1500 ppm) in a similar set up as in the chronic exposures. Experiments were carried out under natural photoperiod (12h:12h) at ambient temperature. No tadpole mortality occurred in any of the treatment or control tanks in chronic exposure when experiment was terminated. There was no significant effect of the pesticide concentration on total length or body mass of the tadpoles at 8th day (one-way ANOVA: total length F=2.04, p>0.05; body mass F=2.2, p>0.05) or at 16th day (one-way ANOVA: total length F=0.6, p>0.05; body mass F=1.07, p>0.05). Tadpoles were examined for malformations but no visible malformations were found. In the acute test, 48 hour LC₅₀ value of MCPA was 903.5 ppm. This LC₅₀ is among one of the highest reported values in toxicological studies in Sri Lanka. This study suggests that ecologically relevant concentrations of MCPA (0.01-1 ppm) might not impair the survival and development of tadpoles of *P. cruciger*, and MCPA has a very low toxicity compared to that of glyphosate (glyphosate 48 h LC₅₀=14.99 ppm). Comparatively, earlier studies have shown that tadpoles exposed to ecologically relevant doses of glyphosate have a significantly lower survival rate (75%), induced malformations (69%) such as kyphosis, scoliosis and edemas and in addition, fitness consequences due to smaller body size at metamorphosis and longer tadpole period. Our results are consistent with several other studies that have demonstrated the low toxicity of MCPA to amphibian larvae (i.e. high LC₅₀ values), and lack of responses in growth parameters at ecologically relevant concentrations. MCPA degrades rapidly in paddy water and is usually found at less than 1ppm levels. Therefore we suggest that MCPA could be used as a relatively safe alternative for glyphosate. Further studies, however, are needed to determine the effects of direct overspray (>2800 ppm) on tadpoles at different developmental stages and to determine interspecific variation in the sensitivity to MCPA.

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DIVERSITY AND DISTRIBUTION OF DOG TICKS IN SRI LANKA

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Ticks are obligate haematophagous ectoparasites of both humans and animals and are also responsible for the maintenance and transmission of many pathogens including bacteria, protozoa, and viruses. Dog ticks are particularly important, not only because dogs are domestic and companion animals, but they transmit many zoonotic diseases to humans. An island-wide survey was carried out to determine the diversity and distribution of tick species that infest the domestic dog (*Canis lupus familiaris*) in Sri Lanka. Ticks were collected from selected sites in all the districts in the wet, intermediate and dry zones from June 2014 to April 2015. Site of attachment of the ticks and intensity of infection were noted down. Ticks were preserved in absolute alcohol and species and life stages were identified morphologically using standard keys and literature. A total of 2,694 ticks were collected from 23 districts from 1,158 dogs of different breeds. Nine species of ticks belonging to five genera were identified: *Rhipicephalus sanguineus*, *Rhipicephalus haemaphysaloides*, *Rhipicephalus turturis*, *Haemophysalis intermedia*, *Haemophysalis bispinosa*, *Haemophysalis turturis*, *Amblyomma integrum*, *Hyalomma* sp. and *Dermacentor auratus*. The most widely distributed species in the overall collection was *R. sanguineus* (61.4%) which was recorded in all the districts except Polonnaruwa. This tick has a three-host life cycle and all three stages; the larva, the nymph and the adults use dog as the host. The dominant tick species in the three zones varied. While *R. sanguineus* dominated the wet zone, *R. haemaphysaloides* and *H. intermedia* dominated the dry and intermediate zones, respectively. *Rhipicephalus haemaphysaloides* and *H. intermedia* are the major tick species infesting peacock and goats in Sri Lanka. Only the adults of *R. haemaphysaloides* fed on dogs. *Rhipicephalus sanguineus* was the dominant species in many districts except Monaragala, Nuwara Eliya, Puttlam, Badulla, Polonnaruwa and Ampara. In these exceptions, *R. haemaphysaloides* was the dominant species, which was the second most abundant species (24.4%) in the collection. The least common species was *Hyalomma* sp. (0.08%) found only in Vavuniya district. In addition to these species recorded in the present study, *R. microplus*, *H. cuspidate*, *H. spinigera*, *H. aculeata*, *A. estuinarium* and *A. clypeolatum* had been recorded previously in dogs. Although *R. sanguineus*, the brown dog tick is considered the most common tick of dogs world-wide, in Sri Lanka it is the dominant species only in the wet zone but not in the dry and intermediate zones. Head was the main site of attachment for most of the tick species with ears as the preferred site while some species, *Haemophysalis* sp., *A. integrum* and *Hyalomma* sp. were found on eyelids. This study reports a total of nine tick species infesting dogs, many of which are known vectors of tick borne diseases of humans and domesticated animals.

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REPRODUCTIVE BEHAVIOR AND EMBRYONIC DEVELOPMENT IN THE GIANT DANIO, *DEVARIO MALABARICUS*

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Model organisms are non-human species, which are used in research and experimentation to extensively study and understand biological phenomena. Among these, fish model systems are ideal for many developmental studies as they show external fertilization, ease of experimental manipulation and rapid development. The Zebrafish, *Danio rerio* has been established as an effective model organism in developmental biology, genetics and neuropharmacology. However, this species is not recorded from Sri Lanka. But the genus *Devario*, which is a close relative of *Danio rerio* is represented by three species in the island. These three species are *D. malabaricus*, *D. aequipinnatus*, and *D. pathirana*. Unlike the latter two species, which are endemic and critically endangered, the indigenous and more common *D. malabaricus* (Giant Danio) has the potential to be utilized as an alternate fish model system in genetic and developmental studies in Sri Lanka. This study was carried out to characterize and document spawning behavior and embryonic development of this native species of fish.

During this study the reproductive ecology and early embryonic development of *D. malabaricus* were studied and compared with those of Zebrafish. Male and female *D. malabaricus* spawned between 3.00 am to 4.00 am and thus showed photoperiodicity as in most other *Devario* and *Danio* species. A special pre-mating or spawning behavior was not observed. Therefore, it was concluded that their courtship behavior last for only several seconds as in many other Cyprinids. *D. malabaricus* exhibited egg cannibalism after spawning and no parental care was observed towards developing embryos, fries/hatchlings or young.

Morphogenetic features of six broad periods of embryogenesis were analyzed using a stereo dissecting microscope. The first cell division during embryogenesis of *D. malabaricus* started 0.75 hours post fertilization (hpf) and the embryos hatched 35-36 hpf. Embryogenesis was categorized into periods of cleavage, blastula, gastrula, and segmentation and each period was observed for 2.5 hours, 3.5 hours, 4.5 hours and 7.0 hours respectively. Gastrulation initiation was observed after 50% epiboly (50% of the yolk cell covered by blastoderm) and gastrulation movements occurred relatively slower than in Zebrafish embryos. Although the overt early developmental process was slower compared to Zebrafish embryos, *D. malabaricus* embryos hatched 7-8 hours earlier than Zebrafish.

Embryogenesis in *D. malabaricus* followed a similar pattern to that of Zebrafish but was observed to have a slower rate of development. However, these embryos hatched relatively faster than Zebrafish embryos.

VASCULAR ENDOTHELIAL CELL DAMAGE BY PATHOGENIC *LEPTOSPIRA*

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Leptospirosis is the most common zoonotic infection worldwide, which is caused by an obligate aerobic spirochete known as *Leptospira*. *L. interrogans* is a pathogenic spirochete, comprised of many serovars and the pathogenicity of each serovar is known to be different. *L. interrogans* Serovar Pyrogenes has been isolated recently from several patients in Sri Lanka. Therefore, the main objective of this study was to investigate the ability of *L. interrogans* Serovar Pyrogenes in damaging human vascular endothelial cells *in vitro*.

Monolayers of EA.hy926 macro-vasculature endothelial cells (ATCC CRL 2922) were formed in *in-vitro* culture. Pathogenic *L. interrogans* Serovar Pyrogenes (*L. interrogans* Pyrogenes) and as a control, saprophytic *Leptospira biflexa* Serovar Patoc (*L. biflexa*) were grown in Ellinghausen-McCullough-Johnson-Harris media containing 10 % rabbit sera at room temperature. Washed *Leptospira* organisms were re-suspended in HBSS and interacted with endothelial cell monolayers at 0.2, 1 and 2 multiplicity of infection (MOI) separately for 1, 2, 4 and 6 hour durations at 37°C. Cell viability and function were determined by sulforhodamine B (SRB) assay and NADPH oxidase activity respectively. Endothelial cell (VEC) apoptosis was assessed comparing morphology and using DNA fragmentation in agarose gel electrophoresis.

Percentage viabilities of VEC even at 6 hours of incubation was > 90 % for all three MOI of *L. biflexa* and was similar to the control (only endothelial cells). In *L. interrogans* Pyrogenes, both MOI 1 and 2 had significantly low percentage viabilities at 6 hour (13 % and 12 % respectively) than that of *L. biflexa* ($p < 0.001$). NADPH oxidase activity was also significantly reduced by 6 hours in VEC interacted with *L. interrogans* Pyrogenes at MOI 1 and 2 compared to the same MOIs of *L. biflexa*. Signs of early apoptosis (formation of echinoid spikes and cell shrinkage) were visible in VEC exposed for 2 hours to *L. interrogans* Pyrogenes at all three MOIs. The presence of fragmented DNA demonstrated the apoptosis of VEC interacted for 6 hours with *L. interrogans* Pyrogenes.

These results demonstrate that interaction of VEC with *L. biflexa* do not damage VEC nor its functions. In contrast, VEC interaction with *L. interrogans* Pyrogenes for 2 hours initiates cell damage, early apoptosis and result in complete death of VEC by 6 hours. These results indicate that, the ability of *L. interrogans* Pyrogenes to damage the VEC may contribute to the pathogenesis of leptospirosis.

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BIOACTIVITIES OF INVASIVE PLANT *AGERATINA RIPARIA*

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Ageratina riparia(Regel) R. King and H. Robinson: (*Asteraceae*), commonly known as ‘mist flower’ is a perennial herb and a known invader in tropical and warm temperate regions of the world. It is an aggressive, fast-growing, moderately shade-tolerant plant with seeds dispersed by wind and water. Here we report, the bioactivities of *A. riparia*, where antioxidant, cytotoxic, phytotoxic and antifungal properties were investigated. The total polyphenolic content was also analyzed. *A. riparia* plants were collected from Ratthota area in the Matale district. Air-dried plant material was ground and a sequential extraction was carried out using CH₂Cl₂ and MeOH. Concentrated CH₂Cl₂ and MeOH crude extracts were subjected to bioassays: cytotoxic activity against *Artemia salina*, phytotoxic activity against two dicots and two monocots (*Amaranthus mangostanus*, *Raphanus sativus*, *Zea mays* and *Oryza sativa*.), antifungal activity against *Cladosporium cladosporioide* and the antioxidant activity using DPPH assay. The total polyphenolic content was assessed using Folin Ciocalteu assay with gallic acid as the standard. The MeOH extracts of leaf, flower and root showed high antioxidant properties (IC₅₀ 17.38, 11.09 and 36.52 ppm respectively; the standard, α -tocopherol 13.46 ppm). The total polyphenolic content was significantly higher in MeOH extract of leaves (102 mg (GAE)/g). In the cytotoxic assay, CH₂Cl₂ extracts of leaf and stem showed promising activity (LC₅₀ 8.86 and 23.63 ppm, respectively in comparison to the standard lactone compound [(4S)-4-methyl-2-(11-dodecynyl)-2-butenolide] with 0.84 ppm). Interestingly, the antifungal activity was observed only in CH₂Cl₂ extracts. All CH₂Cl₂ extracts of the two dicots and one monocot (*O. sativa*) showed greater inhibition on seed germination while MeOH extracts of flower inhibited the seed germination of *A. mangostanus*. The seedling growth of the two dicot species were greatly inhibited by CH₂Cl₂ extracts of root, flower and leaf while MeOH extract of flowers inhibited the seedling growth in *A. mangostanus*. The results indicate the presence of antifungal and allelopathic compounds in *A. riparia*. These bioactive compounds may help *A. riparia* to maintain its invasive nature in introduced ranges.

CHARACTERISATION OF EXTRACELLULAR LIPASE FROM FUNGUS, *CLADOSPORIUM SP*

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Lipases are enzymes that catalyse hydrolysis of fats and oils to fatty acids and glycerol. They are used in many industries such as detergent, food, pharmaceutical, paper manufacture and biodiesel production. Therefore, researchers are constantly working to identify lipases with characteristics which are better suited for their industrial applications. In studies conducted to identify new lipases we isolated a number of fungal species that produce extracellular lipases. Of the isolated fungi, a *Cladosporium* sp. attracted our interest because of the high activities of the secreted enzyme. Here we report the results of work conducted to optimise the culture condition of the *Cladosporium* sp. for lipase secretion and to characterise the enzyme. Optimum condition for lipase production by the *Cladosporium* sp. in submerged cultures was determined by culturing the fungus in basal medium containing varying amounts of olive oil as the carbon source and yeast extract, peptone, ammonium sulphate, ammonium nitrate or urea as the nitrogen source. Highest activity of lipase was obtained when the medium contained 1.5% w/v olive oil and 2.5% w/v yeast extract. Based on initial salting out experiments with fungal culture media, lipase containing precipitates at two ammonium sulphate concentration cut-offs, namely, 0-40% and 40-80%, were collected. Experiments were conducted to compare the properties of the two lipase fractions obtained by ammonium sulphate precipitation. The optimum temperature and pH of the lipase obtained from 0-40% ammonium sulphate precipitates were 50°C and pH 9 respectively whereas the same parameters for the enzyme from 40-80% ammonium sulphate precipitate were 40 °C and pH 8 respectively. These observations suggest that the lipases present in the two fractions may be different. Upon ion exchange chromatography on DEAE-cellulose, the lipase activities in the two precipitates produced different elution profiles further supporting the view that they may contain different lipases. Further characterisation of these lipases from the *Cladosporium* sp. is desirable

LIPASE AND AMYLASE INHIBITORY ACTIVITY OF *CUMINUM CYMINUM* SEED EXTRACTS

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Cuminum cyminum (Cumin) seeds remain popular as a culinary spice. Researchers worldwide have experimentally validated the therapeutic uses of cumin seeds, which are documented in several indigenous healing systems. This study is an attempt to highlight the results of our recent investigations on isolation of lipase and/or amylase inhibitors from *C. cyminum* seeds which support their acclaimed medicinal attributes in traditional medicines. The crude methanol extract of *C. cyminum* was partitioned by stepwise solvent-solvent extraction using hexane, ethyl acetate, methanol and water sequentially. Lipase inhibitory activity was determined using 2,3-dimercapto-1-propanol tributyrates as the substrate and porcine pancreatic lipase as the enzyme. Amylase inhibitory activity was assessed using porcine pancreatic amylase and soluble starch as the substrate by the chromogenic 3,5-dinitrosalicylic acid (DNSA) method. Lipase inhibitory and amylase inhibitory activities of each extract were determined in triplicate on three consecutive experiments. *C. cyminum* seed extracts showed potent lipase inhibitory activity, however the amylase inhibitory activity of the seed extracts was insignificant. Although all four extracts of cumin seeds showed lipase inhibitory activity, amylase inhibition was only exhibited by the methanol and ethyl acetate extracts, while the hexane and water extracts of cumin seed did not show amylase inhibition. Highest lipase inhibitory potency was observed in the ethyl acetate extract (67.07%) of cumin seed. Hexane, methanol, and aqueous extracts of cumin seed showed 44.30%, 50.86% and 4.82% lipase inhibition respectively. The highest amylase inhibitory activity was displayed by the methanol extract (7.78%) of the cumin seed, whereas the ethyl acetate extract showed 5.54% inhibitory activity. The results of this study indicated that *C. cyminum* seeds have potent lipase inhibitory activity and have the potential to be used in health foods and in nutrient supplements for the management of obesity and hyperlipidemia.

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BIOACTIVITY OF EXTRACTS FROM FRUITS OF LIMONIA ACIDISSIMA

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Limoniaacidissima (Sinhala: divul; English: wood apple), Family Rutaceae, is found growing in tropical countries including Sri Lanka, Bangladesh, India and Pakistan. Fruits of *L. acidissima* are edible and popular in Sri Lanka and shows high harvest throughout the island. But the fruits are only consumed locally and fruit crops are under exploited by the community. In a continuation of our study towards the search for bioactive compounds from edible fruits in Sri Lanka, we studied the bioactivity of solvent extracts of the fruits of *L. acidissima*. The edible part of the well ripened fresh fruits was blended with water using a domestic blender, filtered and the filtrate was extracted successively with *n*-hexane (JH) and ethyl acetate (EtOAc) (JE). The aqueous phase was freeze dried (JW) and the residue was sequentially extracted into *n*-hexane (RH), EtOAc (RE) and methanol (MeOH) (RM) using a sonicator. A fraction of the MeOH extract was partitioned with *n*-butanol (BuOH) (RMB) and water (RMW). Organic solvents were evaporated using rotary evaporator. All the extracts were screened for α -amylase enzyme inhibitory activity, antifungal activity using thin layer chromatography (TLC) bioautography against *Cladosporiumcladosporioides*, antioxidant activity [1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity], brine shrimp lethality activity against *Artemiasalina* and anticandidal activity against five candida species: *Candida albicans*, *C. glabrata*, *C. krusei*, *C. parapsilosis* and *C. tropicalis*.

IC₅₀ values for α -amylase enzyme inhibitory activity for JE, RE and RMB extracts were 975, 1683 and 2439 ppm respectively. IC₅₀ values for DPPH radical scavenging activity for JE, RE, RM, RMB and RMW extracts were 495, 531, 585, 630 and 401 ppm respectively. LD₅₀ values obtained from brine shrimp lethality assay for JE, JW, RE, RM, RMB and RMW extracts were 28, 36, 30, 238, 32, and 50 ppm respectively. Other extracts were found to be inactive for above assays. None of the extracts showed antifungal activity. The EtOAc extract of fruit juice showed activity against one *Candida* sp., *C. parapsilosis*.

The EtOAc extracts of fruit juice and residue showed significant bioactivity against some of the assays performed. TLC patterns of EtOAc extracts obtained from residue and juice showed similar patterns. Hence the two EtOAc extracts were combined and chromatographed over silica gel, RP-silica gel, Sephadex LH-20 and RP HPLC to furnish four high polar UV active compounds. Structure elucidation and the determination of bioactivity of pure isolates are in progress.

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**HETEROGENEOUS ZnO/CuO COMPOSITE AS A CATALYST FOR
PRE-ESTERIFICATION OF HIGH FREE FATTY ACID CONTAINING
COCONUT OIL:
FOR THE PRODUCTION OF BIODIESEL**

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For the biodiesel production, base catalyzed transesterification is preferred because; it is faster than acid catalyzed pathway. But, high free fatty acid (FFA) containing (FFA > 2%) plant oils or animal fats are not qualified for direct (single step) base catalyzed transesterification due to serious operational problems such as requirement of more catalysts which leads to high cost, soap formation, making products separation more difficult and yield reduction. Additionally, more water will be formed which will retard the main reaction etc. To overcome above problems, a two step method is widely used instead of one step method. There acid catalyzed pre-esterification is done first to reduce FFA content below 1% and followed by alkali catalyzed trans-esterification. Additionally, heterogynous solid catalyst utilized chemical pathway is much greener and more economic than homogeneous catalyzed pathway for pre-esterification. In the present study, ZnO/CuO catalyst was synthesized through micelles assisted method and utilized for the pre-esterification of FFA in the coconut oil. Effects of major factors for the reaction (reactant ratio, catalyst concentration, reaction temperature and reaction time) were studied using response surface methodology (RSM) and central composite rotatable design (CCRD) and results were fitted to quadratic model. By solving proposed model, optimum temperature, methanol to oil molar ratio, catalyst concentration and reaction time for maximum conversion (81.95%) were obtained which is about 60°C, 15:1, 1.93 wt. %, and 177.41 min respectively. Therefore, the developed catalyst could be effectively used to reduce FFA in coconut oil for the production of biodiesel.

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STERIC EFFECTS OF SUBSTITUENTS ON FURYLFULGIDE MOLECULAR SWITCHES

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Compounds having two stable states have garnered much interest due to their potential application as molecular switches, especially in digital memory. 3-Furylfulgides (2, 5 - dimethyl-3-furylethylidene) are photochromic compounds which can act as molecular switches due to the presence of an intensely coloured closed (C) isomer and a colourless open (E) isomer. Suitable substituents can change the relative energy levels of the isomers, increase the efficiency of the photodynamics, and also minimize unwanted side-reactions. However, the understanding of these substituent effects is still largely empirical. In this theoretical study, the influence substitution at the central cyclohexatriene (CHT) ring was studied using four substituents: 2-propenylidene (**1**), 2-butenylidene (**2**), cyclopentylidene (**3**), and cyclohexylidene (**4**). Starting from the solid state crystallographic structural data of the E isomers, optimal geometries of the E and C isomers were determined in the gas phase using B3LYP/6-31G(d,p) calculations. Through these calculations the relative stability of the ground state isomers were calculated. Furthermore, the strain on the CHT system due to different substitution was studied. It was found that the relative energies of the E-isomer with respect to the C-isomer do not correspond to the steric bulk of the substituent group. Moreover, the collective effects of the ring strain on the substituent, and the perturbation of the CHT from planarity, also contribute to the overall energy trends of 3-furylfulgides. These results may be useful in the future design of more efficient molecular switches.

AN EFFICIENT POLYACRYLONITRILE BASED QUASI-SOLID-STATE ELECTROLYTE FOR DYE-SENSITIZED SOLAR CELLS**A.M.C. Senevirathne^{1,2}, V.A. Seneviratne^{1,3*}, O.A. Ileperuma^{1,2}**¹*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*²*Department of Chemistry, University of Peradeniya, Sri Lanka*³*Department of Physics, University of Peradeniya, Sri Lanka***sene7403@yahoo.com*

Dye-sensitized solar cells (DSCs) have been attracting the interest of modern scientific research and industrial applications due to their low cost and easy fabrication procedures. These solar cells have already achieved light-to-electric conversion efficiency of 12% with the conventional iodine liquid electrolyte. However, commercializing the device is being held due to leakage problems, solvent evaporation, high temperature instability and flammability associate with the liquid based electrolytes. To overcome the above problems quasi-solid-state electrolytes were introduced to DSCs as they possess good stability, non-flammability and good conductivity due to their cohesive nature of solids and diffusive nature of liquids. In this work, a new quasi-solid-state electrolyte was developed using polyacrylonitrile as the polymer, tetrapropylammonium iodide as the salt, γ -butyrolactone (γ -BL) and ethylene carbonate (EC) as plasticizers and iodine. 4-tert-butylpyridine (TBP) was added as an additive to the gel electrolyte. Different weight ratios of plasticizers, polymer and salt were examined in order to obtain the best gel-polymer electrolyte composition. Total Plasticizer weight ratio (w/w) was varied 80%, 70% and 60% respectively along with the total weight ratio (w/w) of polymer and the salt as 20%, 30% and 40% respectively. The best ionic conductivity was achieved with the electrolyte which composes of 70% (w/w) of plasticizers and 30% (w/w) of polymer and salt. Then each plasticizer, polymer and salt weight ratios (w/w) were again tuned by keeping the total weight ratios with in the above limit and the best composition of polymer, salt, γ -BL and EC were 13%, 17%, 30% and 40% respectively. The highest ionic conductivity value of 3.97 mS cm⁻¹ was achieved for the optimized gel electrolyte. The triiodide diffusivity value of the gel electrolyte was 1.46×10^{-7} cm² s⁻¹. The dye-sensitized solar cells were assembled according to the configuration of FTO/TiO₂/N719 dye/gel electrolyte/Pt/FTO and the light to electrical energy conversion efficiency of 4.52% was achieved with the best gel polymer electrolyte. After hot pressing the cell, efficiency value of the device increased to 5.97%. The open circuit voltage and the saturated current density values were 0.687 V and 14.2 mA cm⁻² respectively. DC polarization measurement confirmed the ionic nature of the gel electrolyte.

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MIGRATION OF TOLUENE INTO ARTIFICIAL SALIVA FROM NATURAL RUBBER LATEX BALLOONS MARKETED IN SRI LANKA

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Among organic hazardous substances, toluene is recognized for its hazard potential due to its ability to cause reproductive defects, neurological damage and act as a central nervous system depressant. Toluene contamination has been reported in many consumer products, including children's toys and childcare articles. Since balloons are one of the most popular toy items used by children, a detailed scientific study was done to uncover the toluene contamination in balloons. In the current study, eight different brands of natural rubber latex balloons available in the Sri Lankan market were analysed under three categories; imported, local large scale and local small scale manufactured balloons. Each brand was assessed for the presence of toluene by carrying out migrations using an artificial saliva solution at pH 6.8. The resulting solution was repeatedly extracted with dichloromethane, concentrated and subsequently analysed by the gas chromatography-mass spectrometry technique (GC-MS).

The migration of toluene was observed in six out of the eight brands utilized for the study. A point of interest was that toluene migration was almost restricted to local small scale manufactured brands and imported brands of balloons. In almost all cases, the level of toluene exceeded the maximum migratory limit of 2 mg/litre of aqueous migrate, set by the EN 71-9 standard. This corresponded to a variation of toluene level between 0.15 to 0.37 mg/g of the balloon.

Factors affecting the level of toluene migration from the balloon samples were evaluated. They were, the effect of part of the balloon mouthed, storage time of balloons, effect of mouthing conditions and colourants added to balloons. Toluene migration from the neck of the balloons was approximately two times higher than a sample of whole balloons of equivalent weight. It was also observed that the top one inch portion of a balloon contributes approximately to one-third of the toluene migration from the entire balloon. The migratory level decreased as the balloons were stored for a longer time period from the date of manufacture. At the end of an eight month period, the toluene level decreased by more than half of the initial amount. A higher level of toluene migration was observed when the balloons were subjected to mechanical agitation, in order to mimic active mouthing conditions. The observed levels were approximately two times higher than the values observed under stationary conditions. Kruskal-Wallis tests were performed using the MINITAB 14.0 statistical software for toluene levels corresponding to each test criterion; agitated vs. stationary conditions, whole balloon vs. neck of the balloon and at two month intervals. The tests indicated that the values being compared varied significantly under the different conditions employed ($p \leq 0.05$). Another principal revelation of the study was the absence of toluene in colourant free balloon samples, when coloured and non-coloured balloon samples from the same batch of production were subjected to analysis. The results indicated that the presence of toluene can be linked to various solvent based colourants used during balloon manufacturing.

EMERGENT PATTERNS IN SUBGROUPS OF COMPUTATIONALLY MODELED SCHOOL OF FISH

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Collective dynamics is an interesting biological phenomenon that describes the formation of group level dynamics as a result of interactions between individuals. The behaviour of these interactions gives rise to many emergent properties such as self-organization, inter-individual information transfer, group decision-making processes and movement patterns, and inter-individual synchronization. The emergent patterns these groups create are neither entirely regular, nor entirely random. They self-organize themselves into complex patterns without any aid of any external stimulus.

In this project, the computational study by Couzin et al. (2002) is extended to analyze the evolution and emergent patterns (global level) of collective motion of a computationally modeled school of fish on the basis of the behavioural tendencies of each individual with *local interaction rules* (moves in the same direction as its neighbours, remains close to but avoid collisions with its neighbours). The project analyzes the evolution and emergent movement patterns of a school of fish by using group dynamics (clustering within the group) of the school in two and three-dimensional planes. Once the model is simulated for a school of fish with N members, their coordinate matrix corresponding to the positions of each individual is recorded at each time step, t . Sub-groups (clusters) are obtained at each time step using nearest-neighbor (*friends-of-friends*) clustering approach. The robustness of power-law, truncated power law (power-law with an exponential decay) (expect for scale-free behavior from both models) and exponential distribution (expect for random Poisson distribution) model fits to the frequency distributions of number of clusters are tested using model selection approach, i.e. Akaike information criterion, AIC_c to analyze the evolution of group dynamics.

The number of clusters at each time step forms a cyclic/wave-like behaviour regardless of inter particle separation. Based on AIC_c , the probability distribution of number of clusters is best described by the truncated power law model. However, the power-law scaling exponent, $\mu_{\text{trunc,MLE}}$ is not between 1 and 3.

The results show that the sub groups (clusters) the fish make in the school evolves following a cyclic behaviour or a wave-like form indicating self-organizing behaviour. Furthermore, the probability distribution of number of clusters does not follow a pure power-law distribution showing no support for scale-free behaviour. Although the distribution follows a truncated power law distribution, the power-law exponent, $\mu_{\text{trunc,MLE}} > 3$ also shows no support for self-organization. Therefore, the results (showing no support for scale-free behavior) of the probability distribution of the change in sub-grouping suggest that the fish formed a relatively lower number of large clusters than if fish cluster size was fitted by a comparatively fat-tailed power-law model (i.e. have larger number of large clusters). This pattern could be the most conducive to balancing repulsion and attraction incorporated in the model. Our results are in agreement with previously reported empirical studies which show that fish school size distributions are fitted by many different models and are often context dependent.

EVALUATION OF *ALOE VERA* HERBAL LEAF GEL AS A BIO PRESERVATIVE OF FRUITS OF *AMPALAVI* MANGO

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The herbal plant, *Aloe vera*, is one of the potential plant for its application in indigenous medicine. The gel obtained from the leaves of *A.vera* has numerous properties. One of the properties was studied to extend the shelf life of mango fruits of a cultivar *Ampalavi* by smearing the gel on the fruit skin. Even sized, uniform shaped and coloured, matured mango fruits were surface cleaned and coated with 33%, 66% and 100% gel. Due to the coating, the ripening process was delayed, The TSS (Total Soluble Solid), pH and weight loss were high in uncoated fruits. The mean pH of the pulp of control fruits was 4.94 at 4 days Fruit preservation period (FPP) and was slightly increased to 5.43 within 12 FPP, whereas minimal pH was noticed in 100% (4.69 at 4 FPP and 5.03 at 9 FPP) gel coated fruits. The TSS was significantly at higher levels (13.67 within 4 FPP and 20.77 within 12 FPP) in fruits kept as control, whereas the minimum TSS value was 9.27 and 18.03 within 4 and 12FPP, respectively, and recorded from the 100% gel coated fruits during storage. The WLP (Weight Loss Percentage) was significantly ($p<0.05$) higher in control fruits (8.46%) whereas lower WLP (1.13%) was found in 100% gel coated fruits after 12 days of storage. The gel coating had a significant change on the mango fruits and it prolonged the fruits shelf life by delaying the ripening and preventing the microbial activities due to their antimicrobial properties. This natural leaf gel could be used to protect the fruits from early ripening and prevent microbial contamination during post harvest storage.

PROBING THE MEDICINAL VALUE AND ANTIOXIDANT ACTIVITY OF THE WILD MUSHROOM *ATHURU HATHU* (*AGARICUS FULVOALBUS*) FROM THE SINGHARAJA RAIN FOREST

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Consumption of mushrooms as a part of the diet has increased remarkably due to their significant role in human health and nutrition. In traditional medicine throughout the world, mushrooms have been used due to its valuable medicinal properties. Since edible *Agaricus* species are imbued with high commercial and medicinal value, the present study is done on *Athuru hathu* (*Agaricus fulvoalbus*), which is a seasonal wild mushroom found in the Sinharaja rain forest, Sri Lanka. *Athuru hathu* is popular among the community living around Sinharaja rain forest, due its great flavour and texture similar to pork and ability to be stored for a considerable period of time without any preservative.

This, the first research on wild mushrooms found in the Sinharaja rain forest, study has uncovered phytochemicals, antioxidant activity, antibacterial activity and antifungal activity of *Athuru hathu*. The phytochemicals present in this mushroom were screened as these directly affect the human health. Due to the evidence of its comparatively long shelf-life, the antibacterial activity against Gram negative bacteria and Gram positive bacteria was screened using the well diffusion method and micro dilution plate method. Antifungal activity was screened using the poisoned food technique and antioxidant activity was analyzed using the DPPH assay because of the importance of antioxidants to human health as it draws the attention of the public.

Phytochemical screening of the methanol extract detected the presence of alkaloids, unsaturated sterols, flavonoids, tannins and polyphenols while saponins were absent. Screening for the antibacterial activity of the methanol extract showed inhibition zones for *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Ralstonia solanacearum* and hexane extract showed inhibition zones for *S. aureus* and *B. subtilis*. The minimum inhibitory concentrations of the methanol extract ranged from 0.069 to 0.617 mg mL⁻¹. Antifungal activity was determined using the poisoned food technique and methanol extract showed an inhibition of the growth of *Rhizopus stolonifer*, *Aspergillus niger*, *Aspergillus flavus* and *Penicillium sp.* Antioxidant activity of the methanol extract showed a good antioxidant activity than that of the reported values of other mushrooms.

In addition to its unique taste and longer shelf-life, the results show that the wild mushroom, *Athuru hathu* has a medicinal value to the consumer. Among them, antibacterial, antifungal, and antioxidant activities are of particular interest. Therefore, *Athuru hathu* can be used as a potential functional food substrate and as a source for the development of new drugs.

SQUID AND CUTTLEFISH FISHERIES OFF KALPITIYA IN NORTHWEST SRI LANKA

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In catering increasing demand for local and international markets intensive harvesting of Cephalopods, which consist of squid and cuttlefish, are reported off the waters of Kalpitiya, Northwest Sri Lanka. In Kalpitiya bottom trawling, a prohibited fishing method is used year round in harvesting aggregated large schools of squids and cuttlefish. Meanwhile during spawning seasons, squids which come to pelagic layers around the Baththalangunduwa Island are heavily harvested using hand jig-lines and Fish Aggregation Devices (FAD) such as submerged tree branches. Therefore, this study evaluated the present status of the fishery in northwest Sri Lanka, by collecting weekly random samples from commercial catches landed into Kalpitiya from April to August 2014. Catch records from 2005-2014 were also collected from log books of fish collectors in Northwest region. In addition, for the purpose of reporting Cephalopods species which targeted by fisheries along northwest to southern coastal belt, samples were collected from commercial landings from Kalpitiya in northwest coast, Negombo in the west coast, and Matara in the southern coast. From species sampled weekly from northwest coast, morphometric relationships, seasonal abundance were determined. Further, gut contents were analysed to check whether squids and cuttlefishes have a feeding aggregation. In this study, squid species: *Sepioteuthis lessoniana*, *Loligo duvauceli*, *Sthenoteuthis oualaniensis*, *Loligo singhalensis*, and cuttlefish species: *Sepia aculeata*, *Sepia ramani*, and *Sepia pharaonis* were identified as commercially important species. Among them *S. ramani* and *Sthenoteuthis oualaniensis*, which reported from southern coast, had not been reported from Sri Lankan waters previously. Further, white dotted stripe was observed in mature *S. lessoniana* males as an external identification feature. Large numbers of squid egg capsules attached to FADs were found to be destroyed due to frequent lifting of FADs. Though increasing hand-line squid catches were evident in northwest regions, from 2005-2014, declining trawl production which targets large individuals was observed during the same period from northwest region. This could be due to intensive targeting of spawning individuals and destroying their eggs through intensive hand-line fishery. Monthly catch per unit effort (CPUE) comparisons revealed high bottom trawl catches in non-monsoonal period, while high hand-line catches in monsoons when squids tend to spawn. Sharing of same food resources as evident by gut content analysis, confirms squids and cuttlefish aggregation is likely to be a feeding aggregation. A longer term study to understand the population dynamics is timely for managing this fishery.

KINETIC AND THERMODYNAMIC STUDY OF PHOTO-INDUCED OXIDATION OF ALOIN TO ALOE-EMODIN

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The therapeutic activity of aloe-vera has lead to wide incorporation of aloe-vera extracts in skin care products. Aloin and aloe-emodin are anthraquinone derivatives present in the aloe latex, which can be present in commercial products. However, these can be harmful as they can form reactive oxygen species upon ultraviolet (UV) irradiation leading to enhanced carcinogenicity. Aloe-emodin has an affinity to form reactive oxygen species as it readily forms singlet oxygen species upon irradiation. In this research, kinetic and thermodynamic parameters were studied in a photo-induced oxidation reaction using rate measurements and computational methods. Photo- induced oxidation to form aloe-emodin from aloin upon ultraviolet irradiation was examined through UV-Visible spectrophotometry. As kinetic parameters, the rate of formation of aloe-emodin was obtained using integrated rate laws. An Arrhenius plot was constructed to calculate the activation energy; through which the Arrhenius constant for the reaction was evaluated. Through ab-initio calculations ΔH , ΔS and ΔG values of the reaction were approximated. Hence, the feasibility of the reaction was proven. As the formation of aloe-emodin from aloin is a spontaneous exothermic reaction, the amount of aloin in commercial products, which are based on Aloe vera, must be below the permissible level, to avoid the eventual formation of aloe-emodin.

**IMPROVING TARGETED DELIVERY AND ATTEMPTING
SLOW RELEASE KINETICS OF THE TEMPLATE DRUG
COPPER bis-(8-HYDROXYQUINOLINE) BY ENCAPSULATING IT IN
HYDROXYAPATITE NANOPARTICLES**

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Latter-day studies have revealed that hydroxyapatite (HA) enhances clinical effectiveness, with reduced toxicity through broadening the spectrum of drug delivery since it is biocompatible and it can be targeted towards tumour cells rather than using traditional chemotherapeutics. Furthermore, metal-based antitumor/anticancer drugs play a major role in chemotherapy. Use of copper complexes along with coordinating groups happens to be appealing since they are less toxic and are endogenous. It has demonstrated that the properties of Cu(II) coordinated compounds are predominantly influenced by the nature of donor atoms and ligands bound to the central metal atom. The objective of this study is to investigate the potential of enhancing controlled drug release of the template drug copper bis-(8-hydroxyquinoline) by encapsulating it in hollow hydroxyapatite nano-carriers synthesized by following different routes. Herein, the template drug is synthesized using cupric chloride (CuCl_2) and 8-hydroxyquinoline. The method of synthesizing HA nano-carriers is differentiated by (a) simultaneous addition of calcium sucinate and ammonium dihydrogen orthophosphate ($\text{NH}_4\text{H}_2\text{PO}_4$) into the medium containing the template drug as the co-precipitation method and (b) following a physisorption method where the template drug is physisorbed onto porous HA NPs. In synthesizing nano porous HA NPs, calcium carbonate is used as NP template to create voids in HA. By varying the volume ratio of sodium carbonate (Na_2CO_3) and $\text{NH}_4\text{H}_2\text{PO}_4$ (as 100:100, 133.40:66.60, 66.60:133.40) the amount of voids and their sizes are altered. In each method, we ensured Ca/P ratio to be kept at 1.67:1. Analysis of the encapsulating efficiency and drug loading capacity was done with the assistance of Atomic Absorption Spectroscopy (AAS). Examining their crystallinity and morphology are done using X-ray diffractometry (XRD) and Fourier Transform Infrared (FT-IR) spectroscopy while elemental composition is investigated via X-ray Fluorescence (XRF) studies. Analysis lead to the conclusion that, copper bis-(8-hydroxyquinoline) anticancer drug can be encapsulated into hydroxyapatite nano-carriers through co-precipitation and physisorption. Moreover, nano-porous hydroxyapatite exposes more surface area for copper bis-(8-hydroxyquinoline) to get incorporated.

PLATINUM FREE DYE-SENSITIZED SOLAR CELL WITH SRI LANKAN VEIN GRAPHITE/POLYANILINE COMPOSITE COUNTER ELECTRODE

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Dye sensitized solar cells (DSC) are emerging as promising materials, which use renewable solar radiation for ever increasing energy crisis. The counter electrode is one of the main components in a DSC, which functions to catalyze the reduction of redox species and to collect electrons from the external load to the electrolyte. Platinum (Pt) loaded fluorine-doped tin oxide (FTO) is the most widely used counter electrode materials in DSC. However, Platinum (Pt) is an expensive noble metal (~ \$ 1067 per troy ounce at present), and its low abundance, decrease in catalytic activity when expose to dye solution encourage the new inventions of new counter electrode materials. 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. Aniline was *in-situ* electrochemically polymerized on a FTO glass substrate in the presence of graphite to prepare the graphite/polyaniline composite counter electrode. In these composite films, the polymer is expected to act as a conducting support and graphite to act as the catalyst for the reduction of redox species. The performance of the new counter electrode was studied by analyzing the I-V characteristics of the DCS and they were further characterized by using cyclic voltammetry (CV) and Fourier Transform Infrared spectroscopy (FTIR). The highest efficiency of 4.74% was obtained with 702 mV of V_{oc} , 9.85 mA cm⁻² of J_{sc} , and 68.5% fill factor.

DEVELOPING A MASS CULTURE PROCEDURE FOR SOME POTENTIAL PHOSPHATE BIOFERTILIZERS USING AGRICULTURE WASTE PRODUCTS

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Native soil microorganisms, *Aspergillus aculeatus* and *Burkholderia* sp. have the potential of solubilizing Eppawala Rock Phosphate (ERP), which is a cheap and environmental friendly source of phosphate fertilizer. Mass culturing of microorganisms is a key step, prior application to pots/field. This study aims to develop a suitable Mass Culturing Medium (MCM) for *Aspergillus aculeatus* and *Burkholderia* sp. using five different agricultural waste materials: rice straw, rice husk, coir dust, saw dust and sugarcane bagasse were employed as base material. Those were supplemented with broken maize seeds and rice bran. The base materials were tested alone and in combinations either with broken maize seeds or rice bran at the ratios of 1:1, 2:1, 3:1 and 5:1. Three replicates from each combination were inoculated with 0.25 ml of spore suspension (1×10^7 spores/ml) of *A. aculeatus*, mixed and incubated for 7 days at room temperature and the spore counts were obtained. The time of incubation was decided based on visual observation of heavy sporulation. Suitable MCM was selected based on statistical analysis of significant spore counts. Optimum incubation time for *Burkholderia* sp. on some selected MCM was determined initially. For this, 0.25 ml of *Burkholderia* suspension having a density of 1×10^8 colony forming units (cfu)/ml was inoculated in to MCM mentioned above, mixed thoroughly and incubated for different time periods i.e. 24, 48, 72, 96 and 120 h at 30°C. Three replicates were maintained. Thereafter, 38 ml of sterile NaCl solution (0.5%) was added and shaken at 100 rpm oscillation, for 30 min., filtered and a dilution series was prepared. Spread plate technique was used to enumerate the bacterial density. Optimum incubation time was selected based on the highest cell density produced. This experiment was repeated for all the MCM by incubating for optimum time selected (i.e. for 24 h). The data were statistically analyzed using SAS 9.0 version, at 5% level of significance. In mass culturing media supplemented with maize/rice bran, initiation of mycelium was observable after 24 h of incubation and the spores started to appear after 2 days, whereas in respective base material the mycelium was observable after 2 days and the sporulation was apparent after 3 days of incubation. Spore counts were obtained on 8 days post-incubation, since significant sporulation could be visualized after 7 days of incubation. Average spore counts per gram of substrate among different MCM were significantly different ($p \leq 0.05$) and the highest fungal spore count of 9.13×10^8 spores/g of substrate was obtained for rice straw supplemented with broken maize at the ratio of 2:1. The optimum incubation time for *Burkholderia* sp. on selected MCM was 24 h and the mean cfu/g of substrate among different MCM were significantly different ($p \leq 0.05$). Accordingly, rice straw and rice bran mixed at a ratio of 1:1 was the best substrate for mass culturing of *Burkholderia* sp.. This study concludes that among the tested materials the best mass culturing medium for *A. aculeatus* and *Burkholderia* sp. were found to be rice straw supplemented with broken maize seeds at a ratio of 2:1 and rice straw supplemented with rice bran at a ratio of 1:1, respectively.

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EFFECT OF SUBSTRATE TEMPERATURE ON OPTO-ELECTRICAL PROPERTIES OF THERMALLY EVAPORATED CdTe THIN FILMS**P.K.K.Kumarasinghe¹, B.M.K. Pemasiri^{1,2} and B.S. Dassanayake^{1,2*}**¹*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*²*Department of Physics, University of Peradeniya, Sri Lanka***buddhid@gmail.com*

Cadmium telluride (CdTe) thin films have drawn considerable interest in recent decades due to their ability of making high efficiency low cost photovoltaic solar cells. CdTe possesses a direct band gap (E_g) of 1.5 eV, which is ideal to harness solar energy at an optimal conversion efficiency and has a high optical absorption coefficient ($>10^5 \text{ cm}^{-1}$) for the visible solar spectrum. This makes a layer of few microns thick CdTe sufficient for the absorption of photons with energy higher than its band gap. In this work, the effect of substrate temperature is optically and electrically investigated for thermally evaporated CdTe thin films.

Thermal evaporation was done by Edward Vacuum Coating Unit using commercially available CdTe powder (Sigma-Aldrich, 99.99%). The chamber was emptied at a pressure below 10^{-5} Torr by the combination of rotary and diffusion pumps. Thin films of CdTe with thickness of 4 μm were deposited at different substrate temperatures from 125 to 300°C.

Optical characterization revealed that the samples annealed at 400°C for 30 min have a lower E_g compared to as-deposited films for all substrate temperatures. This can potentially be due to the increase of particle size with annealing. In addition, no significant variation of E_g was observed with respect to the substrate temperature, and an average E_g of 1.50 eV was recorded for the annealed samples.

In order to study the effect of substrate temperature on thermally evaporated CdTe thin films (annealed at 500 °C for 20 mins), the resistivity of the samples were measured both before and after chemically etching the deposited films. Etching was done using the 'NP etchant' for 10 s. The etchant was Phosphoric acid: Nitric acid: DI-water mixture in the ratio of 70:1:29. Resistivity was estimated using Van der Pauw method. All the chemically etched samples exemplified lower resistivities compared to the un-etched samples, for all substrate temperatures. This is because when the CdTe thin films are etched with NP etchant, CdTe dissolves in HNO_3 and is reduced to elemental Te. This makes the surface of the thin film Te rich, reducing the resistivity.

The lowest resistivity was observed for samples deposited at a substrate temperature of 200°C for both chemically etched and un-etched samples. The sticking coefficient of Te is greater than that of Cd for temperatures around 200°C. Hence at a substrate temperature of 200°C, films are usually Te rich, making the material p-type reducing the resistivity of the film. In addition, the resistivity was found to increase beyond 200°C, due to re-evaporation of Te and subsequent compensation of the CdTe.

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QUANTITATIVE ANALYSIS OF MICROMINERAL CONTENTS IN SIX SPECIESES OF MARINE MACRO ALGAE – A PRELIMINARY STUDY

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Seaweeds are classified as large marine benthic algae. In many countries, especially in Asia, they are used as food, pharmaceuticals, cosmetics, fertilizers, etc., Most varieties of seaweeds have been shown to possess many bioactivities and to be rich in microminerals, and hence could improve human health upon consumption. This makes it very important to know the composition, especially that of the microminerals in these plants growing in the Sri Lankan waters.

Therefore, this study was aimed at determining the copper (Cu), chromium (Cr), lead (Pb), zinc (Zn), iron (Fe), nickel (Ni), cobalt (Co), and manganese (Mn) contents of six different species of marine macro algae, obtained randomly from the Kogala beachrock platform in the southern coast of Sri Lanka.

Six species of marine macro algae including *Halimeda opuntia*, *Padina antillarum*, *Sargassum crassifolium*, *Gracilaria corticata*, *Ulva fasciata*, *Sargassum sp.* were collected randomly from the Koggala beachrock platform in the southern coast of Sri Lanka. Copper (Cu), chromium (Cr), lead (Pb), zinc (Zn), iron (Fe), nickel (Ni), cobalt (Co), and manganese (Mn) contents were determined in this study. Washed seaweed samples were dried at room temperature, and again at 40°C in a drying oven for two hours, until a constant weight was obtained. A sample of 2 g of each species was subjected to dry ashing by using a muffle furnace at 550°C for 6 hours. For analysis of mineral contents, 5 mg of each ash sample was dissolved in 1ml of 3% HNO₃ solution. All samples were mixed well. Then, mineral contents were determined by using the atomic absorption spectrometer with graphite furnace.

The ash contents of *H. opuntia*, *P. antillarum*, *U. fasciata*, and *Sargassum sp.* was found to be 57.9, 38.2, 16.8 and 22.9 mg/g (dry weight), indicating that *H. opuntia* and *U. fasciata* record the highest and lowest mineral contents among the species tested.

P. antillarum displayed the highest contents of Fe, Co, Ni, Mn, Cr, and Pb, i.e. 21.219, 0.174, 1.208, 15.191, 11.061, 1.782 µg/mg ash (w/w) among the species tested whilst *U. fasciata* had the highest contents of Cu (1.786) and Zn (6.794). The minimum contents of Fe, Co, Mn and Cr were observed in *Sargassum sp.* Further, *H. opuntia* showed the lowest Ni and Zn contents, whilst *G. corticata* had the lowest contents of Cu and Pb.

According to the above results the highest mineral contents were found in *P. antillarum*, and the minimum in *Sargassum sp.*

METACHROMATIC ACTIVITY OF SOME SPECIES OF MARINE MACRO ALGAE FOUND IN THE SOUTHERN SRI LANKAN COAST

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Seaweeds are large marine benthic algae that are used in many Asian countries as food, pharmaceuticals, cosmetics, fertilizers, etc. Sea weeds contain sulphated polysaccharides and some species have been shown to possess anticoagulant activity similar to heparin. Heparin is a natural anticoagulant which is used as a therapeutic agent in western medical practice, and has a very high market value. Heparin shows metachromatic activity with certain dye compounds such as Azure A, and this can be used as a rough measure of heparin like sulphated polysaccharides in biological samples. In this study we measured the metachromatic activity of six species of marine macro algae found in the Koggala beach rock platform in the southern coast of Sri Lanka.

Samples of six selected species of seaweeds viz. *Halimeda opuntia*, *Padina antillarum*, *Sargassum crassifolium*, *Gracilaria corticata*, *Ulva fasciata*, *Sargassum spp.* were collected from Koggala beachrock platform in Sri Lanka. The samples were washed thoroughly with sea and fresh water successively, dried at room temperature, and again at 40^oC in the drying oven for two hours until constant weight was obtained. Water extraction method was used for the study. The dried samples were pulverized in a household grinder for 5 min and passed through a 100 mesh sieve, to obtain a fine and homogeneous powder. Distilled water, 40 ml, was added to the 2 g of seaweed powder in polypropylene tubes. The samples were subjected to sonication for 1 hour. They were centrifuged at 6500 rpm for 10 min at 30^oC. Then the supernatant was separated and stored at – 40^oC until use. Samples were prepared at dilution series of different concentrations as 2 mg/ml, 4 mg/ml, 6mg/ml, 8 mg/ml, 10 mg/ml, 12 mg/ml, 14 mg/ml, 16 mg/ml, 18 mg/ml, 20 mg/ml. Heparin was used as the standard solution. The stock solution of heparin was prepared at a concentration of 1 mg/ml. The standards solutions of heparin were prepared at dilution series of concentrations as 0.1 mg/ml, 0.2 mg/ml, 0.3 mg/ml, 0.4 mg/ml 0.5 mg/ml, 0.6 mg/ml, 0.7 mg/ml, 0.8 mg/ml, 0.9 mg/ml, 1 mg/ml. Azur B dye, 10 mg., was dissolved in 100 ml of distilled water. The Azur B dye solution, 3ml and 10 µl of samples were added to test tubes and mixed well. Absorbance was read at wavelength between 400-700 nm by using a spectrophotometer.

Authentic heparin showed a metachromatic activity with the Azure B dye, as described in literature for Azure A dye compound. Extract of *U. fasciata* showed very similar metachromatic activity under the same conditions, indicating the presence of heparin like substances. Further, by comparing the absorbance values, we could postulate that 20 mg of the *U. fasciata* extract contains around 0.5 mg of heparin like compounds. However, the mucopolysaccharide extracts of the other five species tested, did not show similar metachromatic activity, although it has been claimed by other workers, that those species also possess metachromatic activity. Among the extracts of six different sea weed species, only *U. fasciata* extract displayed metachromatic activity similar to heparin. Therefore, it is postulated that this species can be used for extraction of polysaccharides with heparin like activity. However, it is important to confirm the anticoagulant activity of these substances with a specific anticoagulant test.

**ISOCOUMARINS AND DIHYDROISOCOUMARINS FROM AN
ENDOPHYTIC FUNGUS ISOLATED FROM THE FRUITS OF
*AVERRHOA CARAMBOLA***

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Secondary metabolites isolated from endophytic fungi have been found to have bioactivities which are beneficial for human health as well as in agricultural crop protection. In a continuation of our studies towards the search for bioactive compounds from Sri Lankan flora we investigated these secondary metabolites produced by an endophytic fungus isolated from the fruits of *Averrhoa carambola*. Fresh ripe fruits of *A. carambola* were triple sterilized. A few segments of the inner fleshy part of the fruit was placed on potato dextrose agar (PDA) medium in a Petri-dish and incubated at room temperature in the dark. After 4-5 days, emerging fungi were sub-cultured to obtain a pure fungal culture. Large scale culturing of the fungus was carried out by inoculating pure fungal culture grown on PDA medium to 1L conical flasks (x 60) containing 400 ml of potato dextrose broth medium. The flasks were allowed to stand at room temp for ten days, then incubated while shaking every other day on a laboratory shaker. After 21 days the ferment media were filtered and the filtrate was extracted with EtOAc. The residual mycelium was extracted into EtOAc using a sonicator. TLC analysis indicated that both EtOAc extracts contained the same compounds. Crude extracts were screened for antioxidant activity against DPPH, antifungal activity against *Cladosporium cladosporioides*, brine shrimp lethality against *Artemia salina*, phytotoxicity against lettuce seeds (*Lactuca sativa*) germination and α -amylase inhibitory assay. Crude EtOAc extract showed antioxidant, phytotoxicity, antifungal activity and brine shrimp toxicity. Chromatographic separation of EtOAc extract over silica gel, Sephadex LH-20 and PTLC furnished two isocoumarins reticulol and 6-O-methyl-reticulol, and two dihydroisocoumarins 5-methylmellein and 7-hydroxy-5-methylmellein which were identified by detail analysis of NMR and MS data and comparison with reported data. Identification of fungal sp. by molecular means and determination of bioactivities of pure compounds are in progress.

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SURFACE MODIFICATION OF γ -Fe₂O₃ NANOPARTICLES AND KINETIC STUDIES ON ADSORPTION OF CHLOROPHENOLS ON Cu-MODIFIED γ -Fe₂O₃ NANOPARTICLES

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Research on maghemite (γ -Fe₂O₃) nanoparticles has received much attention due to their potential applications in areas such as magnetic separation, advanced magnetic materials, catalysis, high-density magnetic recording media and medical diagnostics. Particularly, they are easy to synthesize and modify, and more importantly they are biocompatible due to their low toxicity. In the present study, co-precipitation method was used to synthesize (γ -Fe₂O₃) nanoparticles and modification of the synthesized nanoparticles was done by incorporating another metal ion (Cu²⁺) using the same co-precipitation method at different pH values. Surface modification of the (γ -Fe₂O₃) nanoparticles by copolymers or suitable functional groups, with compounds such as phosphonic acids, carboxylic acid, and amines helps to prevent aggregation of nanoparticles. In this study, surface modification of the nano particles was done using cellulose. Synthesized and modified nanoparticles were characterized using XRD and ATR (FTIR); The size of the particles was in the range of 8-15 nm and the modified samples could be distinguished from the bare particles.

These synthesized (γ -Fe₂O₃) nanoparticles were employed for studying the removal of chlorophenols from the aqueous samples, where the studies were carried out using ortho (o) and para (p) chlorophenols. The adsorption ability of both bare and modified nanoparticles was tested with kinetic studies. UV spectroscopic measurements were used for the kinetic studies and to quantify the removal of chlorophenols. The kinetic data revealed that the binding or removal of chlorophenols follows first order kinetics and the rate of adsorption was higher with Cu-modified particles than with the bare particles. ATR spectral data show the configurations of binding of the chlorophenols to maghemite (γ -Fe₂O₃) nanoparticles.

SYNTHESIS, CHARACTERIZATION AND INVESTIGATION OF ANTIMICROBIAL ACTIVITY OF MIXED LIGAND COMPLEXES CONTAINING PARACETAMOL

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Mixed ligand complexes of transition metal elements is a common class of synthetic antimicrobial agents that have been extensively studied with many different combinations of ligands and metals. This study was focused on the synthesis of mixed ligand complexes of Ni²⁺, Cu²⁺ and Zn²⁺ composed of paracetamol (Para) with either salicylic acid (Sal) or 1-hydroxy-2-naphthoic acid (Nap) as the second ligand which is readily available and inexpensive with some amount of antimicrobial activity.

Hydrated metal nitrates of Ni, Cu and Zn were mixed with paracetamol in an aqueous ethanolic medium in 1:2 ratio and the mixture was refluxed for four hours, evaporated to half of the initial volume and kept overnight to obtain the crystalline product of metal-Para complexes. Mixed ligand metal complexes of Ni, Cu and Zn were synthesized according to the same procedure above by refluxing a 1:1 mixture of metal-Para complex and either salicylic acid or 1-hydroxy-2-naphthoic acid as starting materials. Synthesized complexes were characterized by recording melting points, UV-Visible and FT-IR spectra. Antimicrobial activity of synthesized complexes and their starting materials in 25% ethanol was determined with *Staphylococcus aureus* (gram positive bacterium), *Escherichia coli* (gram negative bacterium) and *Candida albicans* (fungi) using disc diffusion method in Muller Hinton agar medium.

IR stretching frequency of N-H bond, (3426 cm⁻¹) present in free ligand paracetamol and phenolic O-H stretching frequencies of free ligands of paracetamol, salicylic acid and 1-hydroxy-2-naphthoic acid observed at 3325 cm⁻¹, 3233 cm⁻¹ and 3325 cm⁻¹ respectively were absent in all the complexes indicating the formation of mixed complexes with the ligand pairs used through N and O as ligating sites. Further, λ_{max} values of UV-Visible transitions shown by free ligands were also found in complexes with slight deviations.

Mixed ligand complexes synthesized possess antimicrobial activity towards different microbial strains depending on the composition. According to the results of the antimicrobial assay, paracetamol only did not show antimicrobial activity significantly. Enhanced antimicrobial activity was shown by mixed ligand complexes. A significant enhancement in the antimicrobial activity was observed with Cu-Para-H₂O and Zn-Para-Nap complexes against *S. aureus* and Zn-Para-Sal complex against *C. albicans*. The diameters of the zones of inhibition were 23 mm, 15 mm and 20 mm respectively for them. Synthesized complexes show higher degree of enhancement in antimicrobial activity towards *S. aureus* which is a gram positive bacterium than *E. coli*, a gram negative bacterium.

PRESSURE DEPENDENCE OF ELECTRONICALLY CONDUCTING COMPOSITE MATERIALS BASED ON POLYMER AND CARBON

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Conducting polymers are the best choice to be implemented in fabrication of electronic devices as they possess electronic properties of metals and mechanical properties of polymers. The composite materials between a polymer and a conducting material can be also be used as an electronically conducting polymer material. Carbon is a very cheap and abundant element with a wide range of electronic conductivity. The variation of electrical conductivity with pressure will also be an interesting property for various practical applications. The aims of the research work was to identify the suitable types of carbon, the techniques of pulverizing, particle size separation and preparation of composites. The variation of electrical properties with concentration and the applied pressure was studied.

As polymers, poly(ethylene oxide), polyvinylidene fluoride and Isoprene (natural rubber) were used. The activated carbon granules were ground into a fine powder and separated using the terminal velocity method in acetonitrile. The particle size of activated carbon prepared in this method was measured and used to prepare samples. Carbon black was used as it is to make the samples. Weighed amount of carbon particle and polymer were dissolved in acetonitrile or toluene to obtain a viscous homogeneous mixture and poured on to a teflon mould. Then it was dried in air for 24 hrs and in vacuum for another 24 hrs to get a thin membrane of polymer carbon composite. These membranes were cut into thin circular films and placed between two stainless steel discs and used to measure electrical conductivity. To investigate the conductivity variation with applied tensile pressure and compressive pressure the sample were subjected to uniaxial pressure at room temperature. For all the composites the AC impedance was measured using Solatron Impedance Analyser and digital multimeters were used DC conductivity measurements.

Both the AC and DC measurements showed the significant conductivity variation at a same volume percentage for a particular composite. All the composites have shown an abrupt change in conductivity at different volume percentages by different orders of magnitudes which is an clear indication of the percolation thresholds. The poly(ethylene oxide) and carbon black composite has shown the large conductivity variation. The conductivity variation in changing concentration is in the order of 10^3 - 10^5 S cm⁻¹. The rubber and carbon black composite was used for investigating the conductivity variation with pressure. This composite has shown the highest conductivity variation among the three composites. For activated carbon-1 (200 nm) and activated carbon-2 (500 nm) the threshold values are 20% and 27% respectively. For the tensile pressure application the sample with conductivity slightly greater the threshold value showed the decrease in conductivity while for the compressive pressure the sample below the threshold value showed a clear conductivity enhancement.

The result confirms that low cost, electronically conducting polymer composites with reversible and stable physical properties can be prepared using small carbon particles. The critical point at which the conductivity variation occurs can be varied by changing the type of polymer and the carbon particles used. The conductivity variation in changing concentration and pressure is in the order of 10^3 - 10^5 S cm⁻¹ which is sufficient for many practical applications. The electronic behavior of these composites can be improved by reducing the particle size to the nano-scale.

NEST SUCCESS AND SEX RATIO OF HATCHERY RELOCATED GREEN TURTLE (*Chelonia mydas*) EGGS

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Many hatcheries are established in coastal Sri Lanka as an *ex-situ* conservation tool. However, their contribution towards conservation of sea turtles is highly debated. Nest success and sex ratio of the hatchlings are critical part of hatchery management. The present study investigated the effect of nest temperature on hatchling sex ratios and the factors that affect the hatching success of the hatchery relocated green turtle (*Chelonia mydas*) eggs. One of the oldest hatcheries in the southwestern coast in Bentota South was selected as the study site and the data was collected from March to June 2015. The usual practice is that the hatchery keeper buys eggs from poachers, rebury them inside the hatchery and incubate until the hatchlings emerge. The following data were collected from the egg clutches brought to the hatchery: clutch size, time gap between collection of eggs and reburial in the hatchery premises, transport mode and container type used to transport the eggs. Data loggers (iButtons) were programmed to record temperature at every 60 min at 0.5 °C increments and were placed inside the nest to monitor the incubation temperature. Once the hatchlings emerged, incubation duration and percentage hatching success was calculated. Data was gathered from 10 nests with a total of 1,152 of eggs. A high hatching success of 97.3% (range 94.6 - 99.1%) was recorded compared to the hatching success of natural nests (77%) and that of other hatcheries (52%) for green turtle eggs in the same area (Kosgoda; Galle District). Eggs that were reburied within a shorter time gap between egg laying and reburial had a higher hatching success (Pearson correlation $r = -0.905$; $p < 0.05$). The nests dug were of similar depth (65 ± 5 cm), all the egg suppliers had used plastic bags to transport the eggs, and most suppliers had used a bicycle to transport the eggs. The existence of an association between these factors and hatching success was not considered due to unequal distribution of data and confounding effects. The middle third of the incubation temperature, i.e. the critical temperature for sex determination, varied from 27 °C to 33.5 °C. Although this was slightly skewed towards females, data from two other nearby hatcheries reported a severely female skewed sex ratios with middle third temperatures of 29.5 to 36 °C. For green turtles, temperatures below 28°C during middle third incubation period known to produce 90-100% males and temperatures of 30.5 °C or higher produce 94-100% females. Although the data were collected during the same warm months, the presence of shade in the incubation pen in the hatchery used in the present study may have contributed to higher hatching success and expected sex ratios than those eggs incubated in pens exposed to direct sunlight. Nests in direct sunlight result in temperatures near the upper lethal limits for sea turtle development. This in turn results in poor hatching success and a severely female-biased sex ratio of hatchlings. This study highlights the importance of reburying the eggs as soon as they were excavated from the wild to increase the hatching success. Moreover, providing sufficient shade for the incubation pen reduces nest temperatures to pivotal range for green turtle development and produces expected 1:1 hatchling sex ratios and also increases the hatching success.

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ANTIMICROBIAL, ANTIOXIDANT, CYTOTOXIC ACTIVITIES AND POLYPHENOLIC CONTENT OF *HOLARRHENA MITIS* R.Br

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Natural products isolated from higher plants play an important role in drug discovery providing higher amounts of structural and functional diversity. Sri Lanka is a rich source of medicinally valuable endemic flora and fauna. However, their biological importance has not been well explored. *Holarrhena mitis* R.Br is one such endemic plant growing mainly in the dry regions of the low-country up to 1500 feet altitude above sea-level. In Sinhala this plant is called as Kalinda, Kiri-mawara, and Kiri-walla and is used in Ayurvedic medicine for dysentery. During the current study, the antibacterial, antifungal, antioxidant activities and cytotoxicity, as well as the total phenolic content of the dichloromethane, ethyl acetate and methanol extracts of the bark and leaves of *H. mitis* were assessed. The air dried leaves and bark parts were extracted separately and sequentially into dichloromethane, ethyl acetate and methanol and were concentrated. All six plant extracts were screened (in triplicate) for antibacterial activity against selected diarrhea causing bacteria (using agar well diffusion assay), antifungal activity against clinically isolated dermatophytes and standard cultures of *Candida* spp. (using agar well diffusion assay), antioxidant activity (using DPPH radical scavenging assay), cytotoxicity using the brine shrimp (*Artemia 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). All six extracts except for the methanol extract of bark (MB) showed negative results for the antimicrobial activity; MB showed significant antifungal activity producing a measurable zone of inhibition against *C. albicans* (12 mm; positive control(PC) 31 mm), *C. Krusei* (20 mm; PC 22 mm), *M. gypseum* (20 mm; PC 41 mm) and *T. mentagrophytes* (26 mm; PC 45 mm). Plant extracts showed antioxidant activity between IC₅₀ 16.89-473.45 ppm compared to that of α -tocopherol (IC₅₀ 12.22 ppm). According to the IC₅₀ values, the antioxidant activities of all six extracts in the descending order were; ethylacetate extract of leaves (EL, 16.89 ppm) > methanol extract of leaves (ML) > methanol extract of bark (MB) > ethylacetate extract of bark (EB) > dichloromethane extract of leaves (DL) > dichloromethane extract of bark (DB, 473.45 ppm). In the cytotoxicity studies, DB and DL showed the highest cytotoxicity with the LC₅₀ values of 9.38 ppm, 27.13 ppm, respectively while MB was nontoxic with LC₅₀ values of 1223.36 ppm, compared to that of positive control (K₂Cr₂O₇ LC₅₀ 35.74 ppm). The cytotoxicity of other extracts in their descending order were; EB(173.63 ppm) > ML (199.05 ppm) > EL (283.17 ppm). The considerable TPP contents were detected in the ML and EL with the values of 473.2, 138.7 mg (GAE) /g, respectively. These empirical results revealed that the non-toxic MB which possesses prominent antifungal activity would be a potential anti-fungal natural product source and the cytotoxic DB and DL would contain potential natural anti-cancer lead compounds. Future studies will be focused on isolation of anti-fungal compounds from methanol extract of bark and cytotoxic compounds from both dichloromethane extracts of bark and leaves.

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BRYOPHYTE FLORA OF THE KANNELIYA FOREST RESERVE

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Bryophytes are the first group of plants to colonize land and the second most species rich plant group next to angiosperms. They are small, non-vascular plants comprising three phyla, Marchantiophyta (liverworts), Bryophyta (mosses) and Anthocerotophyta (hornworts). Sri Lankan forests covering 23.87 % of total land area facilitate the growth of a vast diversity of bryophytes. Kanneliya is a prominent lowland rain forest in the wet zone and is base for many scientific researches on both flora and fauna. However, no systematic studies on bryophytes within the forest have yet been conducted. Present study was carried out to explore the bryophyte diversity in the Kanneliya Forest Reserve.

Bryophytes were collected from different habitats of the forest including along streams, near caves, along trails and within the forest. They were stored in paper packets prepared according to the Schofield (1985) method, labeled with the locality, geo-referencing data and substrate details. Collected samples were observed for their morphological and anatomical characters using dissecting, light and stereo microscopes. Specimens were identified to their generic/specific level using taxonomic keys, monographs and other available literature.

A total of 94 specimens were collected from different habitats within the forest and 65 specimens were identified to their generic and/or specific level. Identified specimens included 22 liverworts, 43 mosses and no hornworts. They represented 7 families and 11 genera of liverworts; Aneuraceae (*Riccardia*, *Aneura*), Lejeuneaceae (*Ptychanthus*, *Lejeunea*, *Leptolejeunea*), Lophocoleaceae (*Lophocolea*), Lepidoziaceae (*Bazzania*, *Tricholepidozia*), Notoscyphaceae (*Notoscyphus*), Pallaviciniaceae (*Pallavicinia*), Radulaceae (*Radula*), and 13 families, 21 genera of mosses; Bryaceae (*Bryum*), Calymperaceae (*Calymperes*, *Leucophanes*, *Mitthyridium*, *Syrrhopdon*), Dicranaceae (*Leucoloma*), Fissidentaceae (*Fissidens*), Hookeriaceae (*Hookeria*), Hypnaceae (*Ectropothecium*, *Hypnum*, *Isopterygium*), Leucobryaceae (*Campylopus*, *Leucobryum*), Meteoriaceae (*Aerobryidium*), Neckeraceae (*Homaliodendron*), Polytrichaceae (*Pogonatum*), Pterobryaceae (*Pterobryopsis*), Pylaisiadelphaceae (*Taxithelium*), Sematophyllaceae (*Papillidiopsis*, *Sematophyllum*, *Trichosteleum*). Taxonomic descriptions along with illustrations of key characters were prepared for the identified species. Extended field explorations could reveal more taxa, including new records to the country.

This study serves as the first detailed taxonomic study on bryophytes in a lowland tropical rain forest in Sri Lanka; a massive step towards initiating further bryological studies in the country.

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A TAXONOMIC SURVEY OF EPIPHYTIC BRYOPHYTES IN SELECTED LOCALITIES OF THE CENTRAL PROVINCE OF SRI LANKA

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Bryophytes (liverworts, mosses and hornworts) are a well-established group of land plants with a high species diversity and worldwide distribution. They occupy a variety of habitats including soil, rocks, and even manmade habitats like roofs and walls. Bryophytes adapted to live on other vascular plants; epiphytic bryophytes, form a taxonomically diverse group including species from different moss and liverwort lineages. They have adapted to epiphytic habitats throughout a long period of geological time scale and share unique adaptive anatomical and morphological characters making them a single separate group among other bryophytes. Sri Lanka is a tropical country with a rich bryophyte flora yet this important group of plants is poorly studied within the country. There are no checklists, manuals or identification keys for epiphytic bryophytes in Sri Lanka. The study was an initiative taxonomic study carried out on Sri Lankan epiphytic bryophytes.

A total of 212 epiphytic bryophytes were collected from selected localities in the Central Province of Sri Lanka; Loolcondera, Lower Hantana, Peradeniya University premises, Kothmale, Mackwood Estate, Elkaduwa plantation and Riverstone. Morphological and anatomical characters of vegetative and reproductive parts of the collected specimens were observed using hand lens, dissecting microscope and light microscope. Characters were recorded and the specimens were identified up to generic/ specific level using taxonomic keys prepared for epiphytic bryophytes in different regions of the world. Identified taxa included 60 epiphytic genera including 43 genera of mosses in 24 families and 17 genera of liverworts in 9 families including 7 leafy and 2 thalloid liverwort families. Identified bryophytes represented 76 % of mosses in the Phylum Bryophyta, and 24 % of liverworts in the Phylum Marcantiophyta comprising 22 % of leafy liverworts and 2 % of thalloid liverworts. Although the genera/species identified have been listed in previous checklists, no details of their habit or habitats were provided. Taxonomic descriptions were prepared for the identified genera/species. A taxonomic key for Sri Lankan epiphytic bryophytes was prepared using the identified epiphytic bryophyte genera. A collection of herbarium specimens for epiphytic bryophytes was prepared. Calymperaceae and Meteoraceae were found to be the most species rich moss families comprising six and five species respectively. The most species rich epiphytic liverwort family was Lejeuneaceae with 15 recorded species. Species recorded included high desiccation tolerants as well as species used as indicator organisms for environmental pollution.

The high diversity of epiphytic bryophytes recorded from these selected localities indicates a rich diversity of Sri Lankan epiphytic bryoflora and highlights the importance of further researches on this important bryophyte group.

MORPHOMETRIC ANALYSIS OF THE GENUS *APONOGETON* IN SRI LANKA

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Despite its small size, Sri Lanka has a rich and diverse flora. It harbors 3,154 flowering plants and there may be many more flowering plant species yet to be described. Understanding and identifying individual species is critical to ensure their conservation. In order to discover new plant species, proper taxonomic studies should be conducted. *Aponogeton* (Aponogetonaceae) is a genus of aquatic plants distributed mainly in tropical or sub-tropical region of the old world. There are about 57 *Aponogeton* species in the world and in Sri Lanka the genus is represented by four species namely *A. rigidifolius* Bruggen, *A. jacobsenii* Bruggen, *A. crispus* Thunb. and *A. natans* (L.) Engler & Krause, of which the former two are endemic, while the latter two are native. Current field observations have encountered members with characters that have not been described under Sri Lankan *Aponogeton*, and a possibility of the occurrence of new members in the genus. Therefore, a detailed morphometric analysis was carried out including all the different morphological variants encountered in the field using 60 samples. Live plants were collected at their flowering and fruiting stages. They were examined for different morphological characters in detail. Seventy four characters were coded into discrete character states and entered into a data matrix. Coded and constructed dataset was analyzed using the PAST (version 2.15) software and subjected to Cluster Analysis (CA) and Principal Coordinate Analysis (PCoA). The dendrogram and the scatter plot that resulted from the CA and the PCoA clearly identified five phenetic groups within the genus *Aponogeton* of which three were identified as *A. crispus*, *A. rigidifolius* and *A. jacobsenii*. Though none of the phenetic groups totally matched with *A. natans* that has been described in literature, it was interesting to note that only the reproductive features of one of the phenetic groups matched with *A. natans*. According to literature *A. natans* possess submerged leaves; however we never encountered submerged leaves in these populations collected from several locations in the island, instead the plants of these populations exhibited upright or floating leaves. The remaining phenetic group possessed proliferous peduncles; a character that has never been recorded for Sri Lankan *Aponogeton*. The only taxa that exhibit this character are *A. proliferus* B. Hellquist & S.W.L. Jacobs and *A. undulatus* Roxb. recorded from Australia and the Asian region, respectively. However, the species with white inflorescence encountered during the present study is morphologically closer to the latter. Further, studies for confirmation of the identity of the members encompassed within these two phenetic groups are in progress.

CHROMOSOME NUMBERS OF THREE ENDEMIC SPECIES OF FAMILY ORCHIDACEAE FROM SRI LANKA

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The family Orchidaceae is one of the largest flowering plant families in the world. According to the latest classification of the Orchidaceae, the family encompasses 749 genera under five subfamilies (Apostasioideae, Vanilloideae, Cypripedioideae, Orchidoideae and Epidendroideae). Sri Lanka possesses 184 species belonging to family Orchidaceae in 78 genera and among those 50 species of 25 genera are endemic to Sri Lanka. The high diversity among species has posed a challenge for taxonomists in grouping them based solely on their morphology. Cytological data; chromosome number, their size, structure and behavior in a given species are important evolutionary characters which assist the analyses of new species and help to classify them. Here we present for the first time chromosome numbers for three endemic species occurring in Sri Lanka belonging to three different genera of the family Orchidaceae. Freshly grown root tip meristems from *Bulbophyllum wightii* Reichb. f., *Eria lindleyi* Thw. and *Thrixspermum pugionifolium* (Hook. f.) Schlechter were collected and pre-treated with 8 – hydroxyquinoline and fixed with ethanol: acetic acid (3:1) solution. Samples were washed with tap water, hydrolyzed in 5N HCl and stained with Schiff's reagent. Slides were analyzed and photographs were taken by Carl Zeiss Axio Imager A1 microscope equipped with a digital camera. Images were processed and karyotypes prepared with Corel PHOTO Paint X7 software. The respective diploid chromosome numbers were *T. pugionifolium* ($2n = 38$), *B. wightii* ($2n = 38$) and *E. lindleyi* ($2n = 38$). According to the Karyotype of *B. wightii*, there are seven pairs of metacentric chromosomes, five pairs of submetacentric chromosomes, two pairs of acrocentric chromosomes and five pairs of telocentric chromosomes. Karyotype of *E. lindleyi* has twelve pairs of metacentric chromosomes, four pairs of submetacentric chromosomes, two pairs of acrocentric chromosomes and a pair of telocentric chromosomes while karyotype of *T. pugionifolium* indicated six pairs of metacentric chromosomes, seven pairs of submetacentric chromosomes, two pairs of acrocentric chromosomes and four pairs of telocentric chromosomes. The data obtained in this study can be used further in evolutionary studies of the family Orchidaceae in Sri Lanka.

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SEED BIOLOGY OF SIX SELECTED RICE FIELD WEEDS IN SRI LANKA

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Weed flora associated with rice fields cause severe yield reduction and cause many other problems in rice cultivation. To plan an effective weed management strategy, knowledge on weed seed biology is important. Therefore, our study was aimed to collect the basic information on seed biology of six selected rice field weeds in Sri Lanka. Seeds were collected at least from five individuals from each species. Dormancy classes of weed seeds were determined using germination and imbibition experiments. Effect of light, dry storage and temperature on dormancy and germination was studied. Experiments were conducted in a completely randomized design. One-way and two-way ANOVA were conducted to analyze the arc-sin transformed data. Effect of osmotic potential on seed germination of non-dormant seeds of selected species was determined using hydro-time modeling. Seeds of *Eclipta prostrata* and *Ludwigia peruviana* were non-dormant where the untreated fresh seeds germinated > 60 %. We conclude that the seeds of *Aeschynomene indica* and *Melochia corchorifolia* are physically dormant as only manually scarified seeds imbibed and germinated to a significant percentage. Seeds of *Cyperus pilosus* and *Ludwigia decurrens* germinated only on GA₃ moistened filter papers, thus they have physiological dormancy. Nondormant seeds of *E. prostrata* and *L. peruviana* required light for germination. To test the effect of dry storage on seed dormancy and viability, the seeds were kept dry at ambient laboratory temperature for five months. This dry storage has reduced the viability of *E. prostrata* seeds. Sensitivity to the seed dormancy breaking treatment in seeds of *A. indica*, *M. corchorifolia*, and *L. decurrens* increased after 5 months of dry storage. Further, dry storage had broken the dormancy of *C. pilosus* seeds. Germination percentage of *E. prostrata* and *L. peruviana* seeds decreased with decreasing osmotic potential in the medium. The calculated hydro-time constant and base water potential for *E. prostrata* seeds at 15 °C were 0.81 and -1.07 MPa, respectively. As a conclusion we can say that weed seeds have diverse seed germination strategies as our project revealed three dormancy classes; non dormancy, Physical dormancy and Physiological dormancy among six tested species. Thus, it revealed that no single dormancy class that is significant for these species to accomplish as weeds.

SOME PHYTOCHEMICAL CHARACTERISTICS AND THE EFFECT OF SEASONAL VARIATION ON ANTIOXIDANT ACTIVITY OF *CELOSIA ARGENTEA* ('KIRIHENDA PALA'): AN UNDER-UTILIZED MEDICINAL PLANT AND A LEAFY GREEN IN SRI LANKA

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Celosia argentea L. ('Kirihenda pala'), which belongs to family Amaranthaceae, is an under-utilized leafy green for which published records are not available for the locally grown accessions. This is recognized as a medicinal plant in many traditional medicinal practices rather than a leafy green in many tropical countries. Horticultural Crops Research and Development Institute (HORDI) at Gannoruwa, Sri Lanka recently initiated research related to *C. argentea* with the aim of popularizing it among general public. The objectives of the current study were to screen the edible parts of the plant for several phytochemicals and antioxidant activity. Qualitative tests were performed for alkaloids (Dragendorff's test), cyanogenic glycosides (picric acid paper test), cardiac glycosides (Kedde test), phenolics (ferric chloride test), phytosterols (Liebermann Burchard's test), terpenoids (Salkowski test), flavonoids (alkaline reagent test), tannins (ferric chloride test), and saponins (froth test). Antioxidant activity of ethyl acetate (non-polar) and methanol (polar) fractions of the plant extracts were assessed by 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay through free radical scavenging ability. The plants were cultivated in the research fields at HORDI. The study was conducted twice during wet and dry seasons of the year 2014, where each trial included six replicate samples. Antioxidant activities of methanolic extracts were higher in both seasons. According to the IC₅₀ values (the concentration of the test sample needed for 50 % inhibition of radical activity), the decreasing order of antioxidant activities of the plant extracts was as follows: dry season methanol fraction (IC₅₀ =593.21 µg ml⁻¹) > wet season methanol fraction (IC₅₀ =775.19 µg ml⁻¹) > dry season ethyl acetate (IC₅₀ =1565.00 µg ml⁻¹) > wet season ethyl acetate fraction (IC₅₀ =1652.74 µg ml⁻¹). Phytochemical tests were positive for alkaloids, phenolics, terpenoids, flavonoids, tannins and saponins for both dry season and wet season plants. Their quantities in different seasons are yet to be analyzed. Our observations agree with reports on *C. argentea* from India, China and Africa in that the same classes of phytochemicals have been detected. Most of these compounds are known to have therapeutic properties, and presence of phenolics, alkaloids, flavonoids and tannins may have contributed considerably to the antioxidant activity. Higher antioxidant activity of the dry season may be due to stress-induced production of certain compounds. Antioxidant activities detected in local *C. argentea* samples were lower when compared to those recorded elsewhere (range 233.3 – 521.4 µgml⁻¹ and data available only for methanolic fraction). Further studies including quantitative assessment of different classes of phytochemicals will provide better understanding of the nutritional/therapeutic value of locally grown *C. argentea*.

CORRELATION OF SEED DORMANCY AND STORAGE BEHAVIOUR TO OTHER SEED AND PLANT TRAITS: A STUDY OF HUNDRAD FABACEAE SPECIES FROM SRI LANKA

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Knowledge on seed biology is important in determining propagation strategies for economically and ecologically important plant species, while in determining eradication strategies for weedy or invasive species. In most occasions finding necessary amount of seeds of these rare species for experiments is difficult. Thus the aim of this study is to identify relationship of dormancy class (Physical dormancy, Physiological dormancy and Non dormancy) and storage behavior types (Orthodox, Recalcitrant and intermediate) with other easy to distinguish plant and seed traits; habit, seed mass, seed moisture, number of seeds per fruit, dispersal type, whether the plant is introduced or native, distribution in Sri Lanka and dispersal unit. In this study, seeds dormancy, storage behavior and other seed characteristics of 103 *FABACEAE* species were used. Most of the studied species have seeds with physical dormancy and orthodox storage behavior. Using Pearson's Chi-squared test, presence or absence of relationships between dormancy and other independent seed trait variables were determined. A multiple logistic regression model was fitted to further confirm the available relationships. However, no relationship was observed between dormancy category and storage behavior. According to the analysis, it was observed that dormancy category is depended on other seed traits; climatic zone of the species, seed moisture content, number of seeds per fruit, fruit types and the dispersal unit of the plant. Also using these significant traits a validated model which has the lowest AIC value was determined. Thus, we can conclude that these traits can be used to predict the seed dormancy class using the logistic regression model. This is especially important to identify the germination treatments and storage methods of seeds of rare species where collection of required amount seeds is difficult for the proper seed dormancy and storage behavior experiments. However, further analysis is required to determine the relationship of dormancy with those traits.

BIOLOGICAL CONTROL OF AVOCADO (*PERSEA AMERICANA* MILL.) STEM-END ROT USING *AUREOBASIDIUM PULLULANS***Y.D.S. Madhupani* and N.K.B. Adikaram***Department of Botany, Faculty of Science, University of Peradeniya, Sri Lanka*
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The stem-end rot (SER), caused predominantly by *Botryodiplodia theobromae*, is one of the most destructive postharvest diseases of ripe avocados. Cultural, chemical and biological control methods are practiced to minimize losses due to SER. The present study investigated the possibility of biological control of avocado SER using *Aureobasidium pullulans* and possible mode of action.

Causal agents were isolated from ripe avocados showing characteristic SER symptoms and the most common SER pathogens were identified. The effect of *A. pullulans* on the growth of *B. theobromae* was tested by dual culture and spore germination assay. Percent colony growth inhibition and percent spore germination of *B. theobromae* were calculated. SER development by *B. theobromae* at ripe stage was assessed following application of *A. pullulans* at the stem-end region of unripe fruits two days prior to inoculation and comparing with untreated controls. This was repeated using unripe fruits with the stalks intact. The percentage area of rot development was determined using a self-prepared scale. All experiments had two trials each with eight replicates. In order to examine if *A. pullulans* treatment induces any defense responses, the chitinase activity, β -1,3-glucanase activity and antifungal activity of the *A. pullulans*-treated fruit peel were assayed. β -1,3-glucanase and chitinase activity were assayed spectrophotometrically after reaction with substrates Pachyman and CM-Chitin-RBV (2 mg ml⁻¹), respectively. Antifungal activity was assessed by TLC *Cladosporium* bioassay of peel extracts. These three experiments were performed once with two, three and four replicates respectively.

B. theobromae and *Pestalotiopsis* sp. were repeatedly isolated from fruits showing SER symptoms. *B. theobromae* was considered as the major SER pathogen since more than 75 % isolates were *B. theobromae* and re-inoculation of fruits with *B. theobromae* alone produced all SER symptoms. Application of *A. pullulans* at the stem-end of fruit, with the stalk intact or not, delayed SER incidence by 2 days compared to the controls ($P < 0.05$). The presence of stalk reduced the SER development in both treated and control fruits, but did not significantly affect the incidence of SER ($P > 0.05$). In the dual culture test, there was no overgrowth of *B. theobromae* or *A. pullulans* on each other throughout the period of 14 days. Somewhat shorter aerial mycelium of *B. theobromae* was observed when the two colonies were in close proximity. The presence of *A. pullulans* cells significantly ($P < 0.05$) reduced germination percentage of conidia of *B. theobromae*. Chitinase, β -1,3-glucanase and antifungal activity of the fruit declined with ripening but chitinase and β -1,3-glucanase activity increased upon pathogen inoculation at unripe stage in both treated and untreated samples. However, this increase was greater in the *A. pullulans*-treated fruits compared to the controls. The rate of natural decline of antifungal activity was slower in *A. pullulans* treated fruits during ripening. The experiments showed that *A. pullulans* application delayed SER of avocado caused by *B. theobromae*. Application of *A. pullulans* two days prior to inoculation and the presence of stalk at harvest might have allowed a better establishment of *A. pullulans*. A combined effect of enhanced activity of chitinase, β -1,3-glucanase and reduced rate of decline of antifungal activity could have delayed the incidence of SER in *A. pullulans* treated avocado fruit.

RELATIONSHIPS OF YIELD AND YIELD RELATED CHARACTERISTICS WITH MATURITY DURATION IN NEAR ISOGENIC RICE LINES

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Development of rice (*Oryza sativa*) varieties with short maturity duration is important in rice improvement programs. The objective of the present study was to ascertain the genetic variability of yield and yield related characteristics and their relationships with maturity duration using near isogenic lines in comparison to cultivated rice varieties. The ideal study to highlight the influence of maturity duration on grain yield would be to compare grain yield of near isogenic lines with different maturity durations in the same genetic background. Near isogenic lines (30) and cultivated varieties (18) were used in the experiment in a randomized complete block design with two blocks as replicates.

Differences of maturity duration, grain yield, yield components and other yield related characteristics among near isogenic lines as well as among cultivated varieties were found to be significant at 1 % probability level. In near isogenic lines grain yield increased with increase in maturity duration from 80 to about 100 days and then was almost stabilized. Number of panicles per hill and 1000 grain weight were independent of maturity duration, whereas filled grain percentage and number of spikelets per panicle correlated with maturity duration. Harvest index was negatively correlated, while above ground vegetative biomass, culm height and all the root characteristics were positively related with maturity duration. The relationships established using cultivated varieties were different from those established with near isogenic lines but that appeared logical, realistic and useful in utilization in plant breeding programs. Rice varieties that mature within 100 days with maximum expected grain yield may be developed. Attention must be paid to increase above ground biomass and root clump length as much as possible in such varieties. However, there is a possibility of developing 90 day varieties without sacrificing much of grain yield.

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EFFECT OF ETHREL CONCENTRATION AND STAGES OF SPRAY ON GROWTH AND SEX EXPRESSION OF BITTER GOURD (*MOMORDICA CHARANTIA L.*)

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Bitter gourd is a monoecious crop with varying proportions of staminate and pistillate flowers. Naturally, it induces greater number of male flowers than the female flowers. Under normal conditions the ratio between male and female flowers of bitter gourd is around 15:1 to 30:1. This flowering behavior is not economical, because it results in lower fruit set and yield, which is a common problem in bitter gourd cultivation. The sex expression of cucurbits can be altered by exogenous application of plant growth regulators. Among the growth regulators tested in various studies, Ethrel (2-chloroethane phosphoric acid) has been found as the most effective to increase the number of female flowers and yield in many cucurbits.

The effect of Ethrel concentration and stages of spray on growth and sex expression of bitter gourd, variety *Thinnaweli White* was studied using 2 factor factorial experiment in a Randomized Complete Block Design (RCBD) with three blocks. Eighteen treatment combinations involving six concentration of Ethrel: 125 ppm, 130 ppm, 135 ppm, 140 ppm, 145 ppm with distilled water as the control and three treatments of spray; at 2-4 leaf stage, flower initiation stage and at both these two stages, were used. All the Ethrel treatments were done on a sunny morning. The solutions were applied exogenously to cover whole aerial part as an aqueous spray, using hand sprayers. Length of vine, number of nodes, internode length, days to first male and female flower appearance, days taken for 50 % male and female flowering, number of male and female flowers and male: female flower ratio were measured.

Effect of Ethrel on vegetative growth parameters was not significantly different among treatments. On the contrary, spraying of Ethrel at flower initiation stage caused significant ($P < 0.05$) delay in male flowering by suppressing male bud initiation and reduced the number of male flowers per vine. Ethrel increased the number of pistillate flowers and hastened the appearance of the first female flower compared to the control. One hundred forty ppm was the best concentration and 2-4 leaf stage was the best stage of application individually, for increasing female flowers per vine. Application of 140 ppm Ethrel at 2-4 leaf stage was the best treatment combination for increasing female flowers per vine as well. Application of Ethrel caused reduction in male to female ratio up to 21:1 compared to the control treatment which reported the highest ratio 31:1. Spraying of Ethrel at different growth stages has a positive effect on femaleness of bitter gourd plant which will contribute to increase in crop yield.

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PRELIMINARY INVESTIGATIONS ON MICROGREENS: AN EMERGING HEALTH FOOD

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Microgreens are tender immature seedlings with fully developed cotyledons with or without true leaves. They are gaining popularity in many countries as a health food. The present study was conducted to determine the germination potential, harvesting stage, antioxidant activity, total polyphenol content and consumer acceptance of species that have the potential to be introduced locally. Seeds were obtained from local retailers. Germination tests were conducted for 10 species in light/dark (12/12 h) and total darkness for 14 days in an incubator (at 25 °C and light intensity 16.4 $\mu\text{mol m}^{-2} \text{s}^{-1}$). Harvesting stages were determined by growing seedlings in the same incubator in light/dark (12/12 h). Consumer acceptance was determined by a 9-point hedonic scale with 50 panelists. Whole seed, sprouts without seed coat and microgreen shoots of green pea, millet and sesame were evaluated for antioxidant activity by 1, 1-diphenyl pycryl hydrazyl radical scavenging activity and total polyphenols by Folin Ciocalteu assay. Germination data were analyzed using independent t-test and total polyphenol content, antioxidant activity and consumer acceptance were analyzed using one way analysis of variance (ANOVA). The germination percentages were significantly higher ($P < 0.05$) in light/dark for millet (*Eleusine coracana*), green peas (*Pisum sativum*), lettuce (*Lactuca sativa*), green radish (*Raphanus sativus*), fenugreek (*Trigonella foenum-graecum*) and sesame (*Sesamum indicum*) (35.3 – 100.0 %) seeds than those under total darkness (13.0 - 55.0 %). Carrot (*Daucus carota*) seeds germinated well under total darkness (56.0 %). The germination percentages in red amaranth (*Amaranthus* sp.), mustard (*Brassica juncea*) and kale (*Brassica oleracea* var. *acephala*) seeds were more or less similar under total darkness and under light/dark conditions. Lettuce seed reached 75 % germination in less than one day while sesame, fenugreek, kale, green radish and green peas within 1- 3 days, whereas millet, mustard, carrot and red amaranth took more than 14 days. Fenugreek and green radish reached the minimum height for microgreens (25 mm) within 4 days, while carrot, green peas, millet, kale, mustard and sesame took 8 days and red amaranth and lettuce took 10-12 days. In millet, the seeds recorded the highest antioxidant activity (IC_{50} 697 $\mu\text{g/ml}$) compared to its sprouts and microgreens. The antioxidant activity in microgreens was significantly higher in sesame (IC_{50} 772 $\mu\text{g/mL}$) and green peas (IC_{50} 1830 $\mu\text{g/mL}$) than their sprouts and seeds. The highest total polyphenol content was in sesame microgreens (4873 mg/100g dry weight (DW)). In sesame and green peas, microgreens showed a higher total polyphenol content than seeds and sprouts, while in millet, seeds showed a higher content (709 mg/100 DW) than sprouts and microgreens. The consumer acceptance rank was high for lettuce (2=like very much) and carrot (3=like moderately), and low for fenugreek and green radish (6=dislike slightly). Seed germination of some study species seems to be affected by light condition. Increase in antioxidants and polyphenols suggest that these compounds are produced during germination and growth. Different choices of consumers may be due to taste, aroma and personal perceiving. These species can be harvested as microgreens within 14 days and the antioxidant and polyphenol content varies between the tested three species and also depends on their growth stage. This preliminary investigation reveals that microgreens can easily be introduced to Sri Lanka.

MOLECULAR AND SEROLOGICAL IDENTIFICATION OF THE BACTERIUM ASSOCIATED WITH WATERMELON FRUIT BLOTCH IN SRI LANKA AND CONFIRMATION OF PATHOGENICITY

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A new disease in watermelon (*Citrullus lanatus*) cultivations showing necrotic lesion on its leaves and blotches on fruits has been reported in many parts of the world since 1987. This was suspected to be watermelon fruit blotch disease caused by the bacterial pathogen *Acidovorax avenae* subsp. *citrulli*. The experiment was conducted to isolate the pathogen associated with symptomatic plants, proving pathogenicity and detection of pathogen through serological and molecular means. The bacterial pathogen was isolated from infected fruits collected from Kalpitiya and Puttlam areas. Cultures on Sucrose-Peptone Agar (SPA) medium showed smooth, round, off-white colored colonies within 24 h. Pathogenicity was proved through fruit pathogenicity assay in which mature watermelon fruits were inoculated by injecting 1 ml of bacterial suspension at 10⁶ CFU/ml with a sterile syringe up to 0.5 cm depth. Rotting initiated within 24 h of inoculation and completed within 3 days. PCR assay using species-specific primer WFB 1 (5'-GAC CAG CCA CAC TGG GAC-3') and WFB 2 (5'-CTG CCG TAC TCC AGC GAT-3'), based on 16S rDNA consistently gave an amplified product of 360 bp with DNA extracted from bacterial pure cultures and infected fruit tissues. Thus, PCR technique confirmed the pathogen in watermelon to be *Acidovorax avenae*. Commercially available Immuno Strips assay proved the pathogen as *Acidovorax avenae* subsp. *citrulli*.

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IMPROVING POSTHARVEST LONGEVITY OF *NEPHROLEPIS HIRSUTULA* (FROST.) C. PRESL CUT FOLIAGE

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Nephrolepis hirsutula (Frost.) C. Presl is an exportable fern, which is not extensively exploited by floriculture growers. Short vase life, which is due to early wilting, leaf yellowing and leaf abscission is a limitation in the export industry. A study was carried out to extend the vase life as well as to improve the postharvest quality of *N. hirsutula*. Foliage were harvested early morning between 7:00 – 8:00 a.m. and they were treated with different concentrations of CuSO₄.5H₂O (0.00, 0.05, 0.25, 0.50 and 1.00 mM), Al₂(SO₄)₃ (0, 50, 100 and 200 mg/L) and benzylaminopurine (BAP; 0.0, 2.5, 5 and 10 mg/L). The sucrose pulsing treatment was carried out with three sucrose concentrations (5, 10 and 20 %). After the pulse treatment, foliage were transferred to the best Al₂(SO₄)₃ treatment which was 50 mg/L Al₂(SO₄)₃. Vase life (VL), relative fresh weight (RFW) and vase solution uptake rate (VSU) were measured. For every treatment 6-15 replicates were used. Vase life evaluation was done under 22 ± 2 °C temperature and 60-70 % relative humidity. Three packaging types *viz*; without polythene or newspaper, only polythene (150 gauge), polythene (150 gauge) plus newspaper were carried out to determine a suitable packaging method for export purposes. After packing they were kept at 10 °C for 24 h (to depict export storage conditions), subsequently transferred to distilled water and the vase life was evaluated.

Copper sulphate treatments did not give any significant increase in VL. Control treatment (distilled water) gave the highest VL. Fifty mg/L Al₂(SO₄)₃, 5 mg/L BAP, pulsing treatment with 5 % sucrose were found to be the most effective treatments which gave a significantly higher ($P < 0.05$) mean VL of 8.5 ± 1.8, 8.4 ± 2.7 and 10.1 ± 1.3 days, respectively compared to their controls 6.2 ± 0.9, 5.5 ± 1.8 and 6.3 ± 1.4 days, respectively. Polythene plus newspaper treatment gave a significantly higher VL which was 10.4 days ($P < 0.05$) when compared to their respective control (7.4 days). Higher concentrations of CuSO₄.5H₂O (0.5 and 1.0 mM) and Al₂(SO₄)₃ (200 mg/L) exhibited phytotoxic symptoms such as burning patches at the tips of leaflets, leaf yellowing and extensive leaf abscission. Fifty mg/L Al₂(SO₄)₃, 5 mg/L BAP, pulsing treatment with 5 % sucrose resulted in the highest mean RFW 94.0, 89.0 and 98.7 %, respectively, compared to other treatments, though RFW of these given treatments were not significantly different. VSU was highly variable among treatments. However, there was no significant difference in VSU among given treatments.

Aluminum ions are capable of inhibiting transpiration from leaves, facilitating water uptake, reducing the vase solution pH, thereby reducing the growth of microorganisms. Exogenously added sucrose acts as a substrate for respiration osmolytes, decreases ethylene sensitivity and promotes the subsequent water relation by acting as osmotically active molecules. Exogenous treatments with cytokinins, such as BAP can delay senescence related events such as abscission and leaf yellowing. Cytokinin-induced delay in senescence is due to the reduction of ethylene production. In conclusion, Al₂(SO₄)₃, Sucrose pulsing and BAP improved the vase life of *N. hirsutula* cut foliage. Polythene with newspaper in combination creates a high relative humidity and reduces water loss with low pathogenic growth. This enhances the storage ability of cut foliage of *N. hirsutula*.

FLORISTIC COMPOSITION OF *JATHIKA NAMAL UYANA* FOREST IN SRI LANKA

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Floristic inventory and diversity assessments are necessary to understand the present status of diversity and conservation issues of biodiversity. Jathika Namal Uyana (JNU) is a forest reserve located near the border of the North Central Province within the dry zone of Sri Lanka having its unique pink quartz rock-outcrop vegetation and *Mesua* dominating community. Present research was conducted to study composition of the flora of JNU. Floristic survey was done from May to September 2014. Thirty 10 m x 10 m quadrats were marked to sample woody perennials adopting random walk method. Thirty 1 m x 1 m quadrats were marked within 10 m x 10 m quadrats to sample herbaceous ground layer community in random manner. The cluster analysis was performed using basal area of woody perennials.

Ninety seven woody plant species belonging to 53 angiosperm families and 24 herbaceous plant species, creepers and climbers belonging to 18 angiosperm families were recorded from JNU during the study. The most dominant Family at JNU was Rubiaceae (8.4%) followed by Euphorbiaceae (7.56%) and Melastomataceae (5.04%) out of all plant species recorded. The Important Value Index (IVI) was highest for *Mesua* sp. (124.34) followed by *Pterospermum suberifolium* (65.31), *Mallotus* sp. (53.37) and *Drypetes sepiaria* (53.25). Among herbaceous plants, creepers and climbers, highest density was recorded by family Cyperaceae (2.10) and highest frequency was recorded by *Croton lacifer* (56.67), while the highest abundance was recorded by *Sanseveria zeylanica* (12.00). Four different plant communities; namely *Mesua* dominated plant community, pink quartz rock-outcrop vegetation, *Memecylon* dominated rock-outcrop vegetation, *Nothopegia beddomi* and *Dimocarpus longon* dominated plant community were identified in this study. Diameter class distribution of trees showed a reverse J-shaped distribution with decreasing density and with increase in diameter. Most of the individual trees have diameters from 1-20 cm (221 individuals, 38.04%). *Mesua* sp. community showed some characteristics of an intentional landscape structure; *i.e.* in most of the places, *Mesua* sp. trees were distributed with more or less same distances and this community was always found along both sides of the foot path. JNU possessed many of the physiognomic features of the typical dry mixed evergreen forests of Sri Lanka. It also contains plant species that are found in the disturbed forest sites in the dry zone of Sri Lanka such as exotic *Alstonia macrophylla* and native *Macaranga peltata*, *Pterospermum suberifolium*, *Mallotus* sp., *Phyllanthus polyphyllus*, *Dimorphocalyx glabellus*, *Glycosmis* sp. and *Leea indica*. Vegetation of the JNU is an atypical *Mesua* dominant dry mixed evergreen community with some typical sub-communities of the region. Presently this reserve is protected and conserved by community level conservation practices (community living around the forest). However, some indications of external influences such as timber cutting, medicinal plant collecting were observed during the study period. Hence, further conservation of this valuable national treasure is essential, with the government patronage.

**EFFECTS OF ORGANIC ADDITIVES ON THE CALLUS INITIATION OF
ANTHURIUM VARIETIES:
ANTHURIUM ANDRAEANUM, *ANTHURIUM ANDRAEANUM*
(LADY JANE) AND *ANTHURIUM HOOKERI***

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Anthurium, (Araceae) is one of the most popular cut flowers in the tropical cut flower industry grown at commercial level. Continual demand of the export market requires propagation of thousands of plants each day. *Anthurium* leaf is highly amenable in regeneration, and hence micro propagation is the most effective method of regenerating new plants. It is proved that many cut flowers have performed well with the existence of organic additives as a supplement to the culture media. This study was conducted to investigate the impact of adding organic additives to the media on the time taken for the callus initiation. Three varieties of *Anthurium* leaf explants (*Anthurium andraeanum*, *Anthurium andraeanum* (Lady Jane) and *Anthurium hookeri*) were used with three types of organic additives (king coconut water, carrot pulp and tomato pulp). Immature leaf parts were established in two types of media, containing organic additives together with hormones (2,4-D 2 mg/l and kinetin 0.5 mg/l) and organic additives alone. Both treatments were supplemented with 50 g/l and 100 g/l of tomato pulp, carrot pulp and 50 ml/l and 100 ml/l of king coconut water to evaluate the efficiency of callus initiation. A complete randomized design (CRD) was used with 10 replicates for all 39 treatments. Time taken for the callus initiation, contamination rate and the survival rate of the explants were recorded. Growth of callus was ranked by visual observation using a visual scale. The data was analyzed by Kruskal Wallis test in the Minitab (version 14.0) statistical software. Effects of media additives on callus induction showed a significant difference at $P \leq 0.005$ level. The highest average rank among the explants (125.5) was scored by the medium with 50 g/l of king coconut water in *Anthurium hookeri*. The next best treatment was the medium with 100 g/l of king coconut water in *Anthurium hookeri* (91.4). The explants with tomato pulp and carrot pulp media did not give a significant difference. The highest survival rate of the explants of all three varieties were recorded with the treatments with king coconut water. Explants supplemented with carrot pulp and tomato pulp was discolored with time. *Anthurium hookeri* showed the highest survival rate with respect to other two varieties. Carrot pulp showed the highest contamination rate and the king coconut water and tomato pulp showed lowest and moderate level of contamination. Eventually the treatment with king coconut water with growth regulators was recorded as the best media composition for *Anthurium hookeri* callus initiation. Presence of cytokinin in coconut water induces the growth and cell division of callus was proved in several studies. The sugar content of the carrot pulp and the tomato pulp could have affected the contamination rate of the culture medium.

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TAXONOMY OF THE FAMILY POLYTRICHACEAE SCHWÄGR. IN SRI LANKA

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Sri Lanka is a country with a rich moss flora consisting 560 species and 185 genera of mosses under 55 families. The moss family Polytrichaceae Schwägr. is comprised of 23 genera and more than 1200 species distributed worldwide. In Sri Lanka, the family is represented by two genera; *Atrichum* and *Pogonatum* with 12 species. There are no taxonomic keys or descriptions to identify the recorded species. This taxonomic study was carried out to study the species diversity of the family Polytrichaceae within the country.

Specimens of recorded species were collected from different geographical locations in Sri Lanka; Adam's Peak, Alkaduwa, Badulla, Corbert's Gap, Deanston, Deraniyagla, Gannoruwa, Horton Plains, Kanneliya Rain Forest, Karagahahinna, Loolcondera, Mahakanda, Nuwara Eliya, Peradeniya University premises, Piduruthalagala, Riverston and Thispane. The collected specimens were surveyed for morphological characters using dissecting and light microscopes. Characters were recorded and species were identified using taxonomic keys and monographs prepared for the family.

The collected specimens represented 7 species of Sri Lankan Polytrichaceae: *Atrichum henryi* (E.S.Salmon) E.B.Bartram., *Pogonatum aloides* (Hedw.) P.Beauv., *Pogonatum marginatum* Mitt., *Pogonatum microstomum* (Schwaegr.) Brid., *Pogonatum neesii* (Müll.Hal.) Dozy., *Pogonatum subtortile* (Müll.Hal.) A. Jaeger. and *Pogonatum urnigerum* (Hedw.) P.Beauv. A taxonomic key to the Sri Lankan Polytrichaceae was prepared and taxonomic descriptions were prepared for all the species identified using their gametophytic and sporophytic characters. A herbarium collection of the species identified was prepared. The study is continued throughout the country with repeated field explorations to collect and identify the remaining species representing the family Polytrichaceae in Sri Lanka.

EFFECT OF BENZYL AMINO PURINE ON SHOOT PROLIFERATION OF APICAL BUDS OF *IN-VITRO* CULTURED *AEGLE MARMELOS* (L.) SEEDLINGS

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Effect of Benzyl Amino Purine (BAP) on shoot multiplication of *Aegle marmelos* (L.), an endangered medicinal tree, was investigated. *In-vitro* cultured *Aegle marmelos* (L.) seedlings were used to identify the most suitable Benzyl Amino Purine (0, 1, 2 and 5 mg/L BAP) concentration for shoot proliferation.

Six weeks after establishment of apical buds, shoot proliferation started on Murashige and Skoog (MS) media supplemented with BAP, while medium without BAP did not show shoot proliferation. However, differences were observed in the place where proliferation of shoots started. Shoot proliferation of apical buds cultured on medium supplemented with 2 and 5 mg/L BAP were observed at the buds while shoot proliferation was observed at the shoot base on the medium supplemented with 1 mg/L BAP. Highly significant difference between shoot height and number of shoot with BAP concentrations were observed ($p < 0.0001$). Longest shoots (2.97 ± 0.2 cm) were observed on the medium with 2 mg/L BAP, which produced 7 ± 0.95 shoots/bud, while highest number of shoots (> 50) was observed at 1 mg/L BAP concentration. Length of the individual shoots could not be measured in the shoot cluster produced on the medium with 1 mg/L BAP due to their small size.

Shoot proliferation of *Aegle marmelos* (L.) was greatly influenced by the presence of cytokinin and MS medium without any growth regulator failed to form any callus or shoot. Production of higher number of shoots at the base of the shoot explant was a new observation and microscopic observations showed that these new shoots were initiated from the cambial layer of the shoot stem.

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**MOLECULAR EVIDENCE CONFIRMS THE OCCURRENCE OF
NYMPHAEA RUBRA ROXB.EX ANDREWS IN
SRI LANKAN FRESH WATERS**

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Native water lilies are wide spread in aquatic ecosystems of Sri Lanka. *Nymphaea nouchali* Burm. f. and *N. pubescens* Willd. has been recorded as occurring in the island. However, another night blooming *Nymphaea* species with deep purplish red flowers that has not been either taxonomically described or recognized in the Flora has been noted in many parts of the country. This plant superficially very much resembles 'Olu', *N. pubescens* and is denoted as 'Rathu-Olu' (Red-Olu) by the locals. A recent morphometric analysis has identified this species as *N. rubra* Roxb. ex Andrews. The present study was carried out to confirm the identity of *N. rubra* using molecular sequence data, *MatK* and *psbA-trnH*. DNA was extracted from both species, amplified for *MatK* and *psbA-trnH* gene regions and sequenced. Sequences were matched with the related accessions deposited in the GenBank. GenBank accessions for the *matK* gene region of *N. rubra* showed 99 % similarity, while it gave a 96 % similarity for *N. pubescens* with query coverage of 97 % and 96 %, respectively. GenBank accessions for *psbA-trnH* were not available for either species. Comparison of the sequence divergence between *N. pubescens* and *N. rubra* sequences indicated a 95 % similarity for *matK* gene region, while 92 % similarity for *psbA-trnH* gene region. The *matK* and *psbA-trnH* sequences divergence obtained between *N. pubescens* and *N. rubra* during the present study has further supported the recognition of *N. rubra*, while the *matK* region has confirmed its identity. The identification of *N. rubra* as occurring in our water bodies has added a new member to the genus *Nymphaea* as well as to the family Nymphaeaceae and, to the angiosperm diversity of the island as a whole.

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EFFECTIVENESS OF ORGANIC ADDITIVES (POTATO, WATERMELON, AND AVOCADO) IN GERBERA TISSUE CULTURE MEDIUM

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Gerbera (*Gerbera jamesonii* Bolus ex Hook. f.) is an ornamental plant, in family Asteraceae. Gerbera is very popular and widely used as a decorative garden plant or as a tropical cut flower. It is the fifth most used cut flower in the world. In Sri Lanka, Gerberas are becoming popular among growers due to the availability of a wide range of long lasting cultivars produced by many modern breeding methods and tissue culture. However, cost for the tissue culture of Gerbera is unbearable for developing countries such as Sri Lanka. New findings on cost effective methods for Gerbera tissue culture will create a significant increase of the Sri Lankan market share in the global floriculture industry. To study the effect of common organic additives (extracts of potato, watermelon, and avocado) in gerbera tissue culture, two varieties (*Gerbera jamesonii* 'Kilimanjaro' and *Gerbera jamesonii* 'Ruby red') were selected and cultured on MS media (10 replicates for each treatment) containing the above three organic additives separately in two concentrations with and without hormone. Capitulum explants from plant house grown plants were used. The media containing watermelon extract and potato extract with hormone showed a significant effect ($p \leq 0.05$) on callus induction and shoot initiation. Media containing 100 g/L watermelon extract with 3 mg/L BAP and media containing 50 g/L watermelon extract with 3 mg/L BAP gave the best results on callus induction and shoot initiation of capitulum explant of *Gerbera jamesonii* 'Kilimanjaro'. Media containing 50 g/L potato extract gave the best results on callus induction of *Gerbera jamesonii* 'Ruby red' followed by the media containing 100 g/L watermelon extract with 3 mg/L BAP and media containing 50 g/L watermelon extract with 3 mg/L BAP. Callus developed from these treatments were healthy, vigorous and green in color. The regeneration from callus was quite complicated and time consuming, than direct shoot generation from the explants. Extracts of potato and watermelon are rich in nutrients, which are essential for growth of plant cells and tissues. Contamination was very high in the media containing potato extract (31.5 %) followed by watermelon media (31 %). In the avocado media, contamination rate was zero, due to the low availability of carbohydrate in avocado. However, the callus induction was very low in median containing avocado extract. Thus, the extracts of watermelon and potato can be successfully used as organic additives in *in vitro* propagation of *Gerbera jamesonii* 'Kilimanjaro' and *Gerbera jamesonii* 'Ruby red'.

ARBUSCULAR MYCORRHIZAL FUNGI IN MONTANE FORESTS AND GRASSLANDS OF DOTHALUGALA MAB RESERVE, SRI LANKA

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Mycorrhizal associations are important determinants of natural forest regeneration on degraded sites. Therefore, the abundance of arbuscular mycorrhizal (AM) associations in grasslands and montane forests in the eastern slopes of Dothalugala Man and Biosphere (MAB) Reserve of the Knuckles Conservation Area was evaluated. Some edaphic factors and their impacts on the distribution and diversity of the AM fungi were also examined. Twelve, 15x15 m² experimental plots were established in the grassland and in the forest (six experimental plots in each land use type). From each plot, six soil samples (up to 10 cm depth) were collected. Soil pH, total organic carbon and soil moisture content were estimated using standard protocols. The AM fungal spore counts were also enumerated. Fine root samples were collected from each experimental plot using soil cores. Further, fine roots of the two common plant species grown in the study area (*Psychotria nigra* and *Symplocos cochinchinensis*) were also collected. Root samples were stored in FAA solution and their arbuscular mycorrhizal fungi (AMF) colonization was evaluated using standard protocols.

A total number of 23 AMF spore morphotypes were recorded from the grassland and forest soils at the Dothalugala MAB Reserve. These included one *Glomus* species, two *Acaulospora* species, two *Gigaspora* species and one *Scutellospora* species. However, 19 spore morphotypes were common to both grasslands and forests. The AMF spore morphotypes richness, spore density and root colonization potential in grassland soils were significantly higher ($p < 0.05$) than those in the forest. Further, the grassland soils contain significantly lower soil organic matter content and soil pH ($p < 0.05$) than that in forest soils, indicating low availability of nutrients in grasslands compared to adjacent natural forests. The low fertility levels at grassland may be attributed to high leaching and erosion losses in these open tussock grasslands compared to dense montane forests. Thus, the AM fungal associations may help the grassland vegetation to survive on low fertile soils. Other factors, such as seed dispersal patterns and predation that also responsible in preventing natural regeneration, should be further tested in seeking solutions for lack of forest regeneration in these highly degraded grasslands at Dothalugala.

RELATIVE IMPORTANCE OF JANZEN-CONNELL AND STOCHASTIC EFFECTS ON SURVIVAL OF DOMINANT TREE SPECIES IN SINHARAJA FOREST

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Understanding species diversity in tropical forests is one of the central questions in Ecology. In this regard, spatial patterns convey important information on the *underlying* processes that maintain species diversity. According to Janzen-Connell effects, tropical forests can maintain high species diversity by reducing the saplings' growth and survival near the conspecific large trees. On the other hand, high stochasticity can also maintain species diversity and survival chance. Therefore, this study is mainly focused on identifying Janzen-Connell effect and stochastic effects associated with two selected species (*Mesua nagassarium* and *Shorea affinis*) in 25-ha Sinharaja forest dynamic plot (FDP) in Sri Lanka.

The diameter at breast height (dbh) and the spatial locations of the two species for the two censuses (1996, 2004) were examined to understand the Janzen-Connell effect and stochastic processes in Sinharaja forest plot. Focal trees (dbh \geq 100 mm) were chosen randomly and proportion of small alive trees (dbh \leq 50 mm) within distance of r radius (0-50 m increased by 5 m) around each focal tree was calculated. Finally, average proportion of survived small trees at each distance was fitted with the distance to the focal trees (r) and this was compared to the departure from randomness by using a simulated homogeneous mark Poisson process to the small trees, while maintaining the spatial structure of focal trees.

According to the study, both species show some degree of clustering in pair correlation functions. Compared to the spatial point pattern of *Shorea affinis*, that of *Mesua nagassarium* has more dense clustering structure. Surprisingly, *Shorea affinis* shows wider departure from randomness compared to *Mesua nagassarium*. Also survivals are lower at small spatial scale due to stochastic effects associated with the species. This outcome is somewhat surprising, because we expect a strong signal of Janzen-Connell effects especially for spatially structured small trees in the presence of many large and small trees at their neighbourhood. However, this analysis is an eye-opener for higher stochasticity found in tropical forests.

PHENOTYPIC VARIABILITY OF SELECTED SRI LANKAN RICE (*ORYZA SATIVA* L.) VARIETIES

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Rice is a staple food of more than half of the world population and cultivated in most countries around the world. Sri Lankan rice germplasm exhibit a wide diversity in agronomically important traits, grain qualities and medicinal values. Therefore, its diversity has a great interest towards plant breeders to use them in crop improvement programs. This study was conducted to identify the characters which contribute to generate variability among selected Sri Lankan rice accessions and to evaluate such variability for the possible exploitation in breeding programs.

In this context, phenotypic variability among 16 rice accessions including six traditional and ten improved Sri Lankan rice varieties was assessed with 19 different traits representing both vegetative and reproductive parameters. Seeds of particular rice accessions were obtained from the Plant Genetic Resource Centre (PGRC), Gannoruwa, Peradeniya, Sri Lanka. Used rice accessions were represented different maturity groups, ranged from 3- 4 ½ months. The data was analyzed using principle component (PC) analysis, single linkage cluster analysis and multivariate analysis of variance (MANOVA).

The first six PCs explained approximately 90 % of the total variation of the nineteen traits studied. Traditional varieties showed the highest PC1 scores and new improved varieties gave highest PC2 scores. Bg 450 (accession number 2835) and Bg 360 (accession number 8920) showed the extremely high scores for both PC1 and PC2, which reflect the similarities in dark green color leaf blades, purplish color basal leaf sheaths, ligules and internodes. All the rice accessions were classified in to four clusters and the existence of these clusters were validated by Wilks' lambda statistics under MANOVA. Bg 300 (accession number 2840) and Bg 305 (accession number 10617) were the morphologically closest accessions. Comparatively high variation was observed among the traditional varieties for their vegetative and reproductive parameters.

This study explored a significant level of phenotypic diversity which exists among different rice varieties. Thus, the measured traits can be used to evaluate phenotypic variability associated with the rice germplasm.

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EVALUATION OF MICROWAVE ASSISTED ALKALINE PRETREATMENT FOR EXTRACTION OF CELLULOSE FROM SELECTED PLANT BIOMASS

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Cellulose is a naturally occurring polymer, and it is the most abundant and renewable polymer in the world. In addition, it is one of the most promising raw materials due to its abundance, and low cost. This can be processed to manufacture biodegradable polymers, bio ethanol, veterinary foods, wood and paper, fibers and clothes, cosmetic and pharmaceutical industries, etc. The compositional characteristics of Corn leaves, Corn husks, Bagasse, Guinea grass and Sugarcane leaves were established in terms of lignin, cellulose and hemicellulose contents, to assess the suitability of lignocellulosic plant biomass for the extraction of cellulose. Pretreatment methods are necessary to remove lignin from lignocellulosic plant biomass. An ideal pretreatment is effective, simple, inexpensive, non-inhibitory and compatible with high biomass loadings. The objective of the present study is to evaluate the performance of the microwave assisted alkaline pretreatment method by applying on five selected biomasses; Corn leaves, Corn Husks, Bagasse, Guinea Grass and Sugar cane leaves, to get the maximum cellulose percentages with optimum pretreatment concentration and minimum time.

This method was performed using a domestic microwave oven. Three different concentrations of prepared Sodium Hydroxide (NaOH) solutions - 1.25 mol/L, 2.5 mol/L and 5 mol/L were used as pretreatment solutions. Total of 25 g of selected biomass with 250 ml of pretreatment solution was added in a 500 ml beaker and irradiated under microwave power of 170 W for 15 min, 30 min and 45min. Forty five treatments consisting of combinations of five biomasses, three NaOH solutions and three time durations were used in the experimental design. Treated mixtures were immersed in 10 % Hydrochloric acid (HCl) for 4 h, washed with tap water once and heated at 60°C for 24 h and kept in a desiccator until a constant weight was reached. Percentages of cellulose were evaluated using chlorination method. Data was analyzed using Minitab 14 version.

Analysis results indicated that biomasses, NaOH concentration, interaction effect of biomasses & NaOH concentration and biomasses & time were significant for percentage of cellulose extracted (cellulose %) ($P = 0.031, 0.005, 0.002$ and 0.000 , respectively). Results indicated that sugarcane leaves have the highest and corn husk have the lowest cellulose % compared to other biomasses. All pretreated fibers consisted of 65 % - 85 % of cellulose. Additionally, increasing NaOH concentration increased the cellulose percentage. Increasing the heating time from 15 min to 45 min decreased the cellulose percentage by non-significant amount. However, the optimum pretreatment condition for microwave alkaline pretreatment for a selected biomasses was found to be irradiation under microwave power of 170 W for 15 min in a 5 mol/L NaOH pretreatment solution.

OCCURRENCE OF PARASITIC PLANTS IN SPICE AND BEVERAGE CROPS OF SRI LANKA

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The occurrence of parasitic plants in perennial spices and many other perennial plant species was observed to be unusually abundant during the recent past in Sri Lanka. Hence, a survey was conducted during November 2013 to May 2015 as part of an ongoing, long term study, in plantations, home gardens and roadsides in the wet and intermediate zones of Sri Lanka covering 14 districts where export agricultural crops (EAC) are grown. The objective was to elucidate the nature of occurrence of parasitic plants in spice and beverage crops, and identify the parasitic plant species and their hosts.

A stratified random sampling technique was used for the survey. Parasitic plants growing on EACs were observed only in seven districts of Sri Lanka, i.e., Kandy, Galle, Kurunegala, Matale, Nuwara Eliya, Ratnapura and Kegalle. However, many fruit trees, shade tree species, timber and other perennial species in all 14 districts were infested with parasitic plants. The EACs, which were affected by parasitic plants at varying degrees, were nutmeg (*Myristica fragrans*), cocoa (*Theobroma cacao*), clove (*Syzygium aromaticum*) and coffee (*Coffea canephora*, *Coffea arabica*). Of these species, the occurrence of parasitic plant infestation was highest with clove (76% of the total infested spice and beverage crops). In some lands, 100% of the clove trees were infested with drastic reduction in plant growth and yield. Other species were infested to a lesser extent (cocoa 9%, coffee 7%, and nutmeg 7% of the total infested spice and beverage crops).

All the parasitic plants identified were hemi-parasites namely, *Dendrophthoe falcata*, *D. neilgherrensis* and *Scurrula cordifolia*, all of which belonged to family Loranthaceae. Of these, *D. neilgherrensis* was most abundant in spice crops (78%) followed by *D. falcata* (20%), and the occurrence of *S. cordifolia* was low (1.8%).

The parasitic plant species could cause a considerable damage to their host plants and the degree of infestation was different in different species of spice and beverage crops. Further studies are required on the increased occurrence of the parasitic plants on spice and beverage crops, and their control.

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PHYSIOLOGY OF CLUSTER ROOT DEVELOPMENT OF *GREVILLEA ROBUSTA* L. WITH DIFFERENTIALLY AVAILABLE PHOSPHORUS IN HYDROPONICS CULTURE

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Grevillea robusta L. (Silver oak/ Silk oak/ *Sabukku*) belongs to the Family Proteaceae and it is widely used as a shade tree in tea plantations in mid and high elevations of Sri Lanka. The roots of this plant have a unique capacity to develop “branch roots” (rootlets) depending on the root environment. Phosphorus deficiency is the main factor for induction of cluster roots.

An experiment was conducted in the plant house of the Department of Crop Science, Faculty of Agriculture, University of Peradeniya, using one-year-old nursery seedlings of *G. robusta* L. in a modified Hoagland solution with continuous aeration. Only the phosphorus concentration of the hydroponic medium was changed, leaving other nutrients constant. Two concentrations of phosphorus were used, 10 mM (standard; +P) and 1 μM (low phosphorus; -P) as the treatments. pH of the solution was initially adjusted to 6.2 and it was not adjusted afterwards as it was taken as weekly experimental datum. The treatments were arranged in completely randomized design with six replicates. Number of cluster roots, length of cluster roots, height of the stem, number of fully expanded new leaves was determined in weekly intervals. Cluster root length was determined with imageJ 1.4 U (Wayne Rasband, USA) software, using digital images of the root system. Plants were destructively harvested at the end of two months, and plant and root fresh weights and plant and root dry weights were obtained.

pH of the -P treatment was significantly lower after 2nd week than the +P treatment. Average number of new cluster roots was significantly higher in -P except in 7th week. Average length of the cluster roots also indicated the same fluctuation pattern. Increasing rate of plant height was significantly higher in +P treatment. Plants in the -P treatment showed a slow shoot growth until the 5th week. After the 6th week shoot growth declined. Leaf initiation rate of +P is also higher than -P treatment. Shoot fresh weight was higher than root fresh weight in +P, and the dry weight of shoots was higher than dry weight of roots in the same treatment. In contrast, fresh and dry weights of roots were higher than shoot fresh and dry weights in -P treatment. Plant height increasing rate was significantly higher in +P treatment. Above ground growth of plants in -P treatment was retarded.

pH rapidly declined indicating the release of acidic compounds (citrate, malate, succinate) to the hydroponic medium as a result of phosphorus deficiency. Root system of *G. robusta* L. tries to compensate the requirement of phosphorus by producing cluster roots. Since the hydroponic medium was consistent, plants in -P treatment may not been able to mobilize phosphorus from the surrounding even though it produced cluster roots. So the plants seem to be producing more roots and increasing root length to reach for phosphorus reserves. Increment in plant height with +P and reduction with -P could be a result of more carbon allocation to the root system. Leaf and above ground growth is hence associated with the slow growth. Higher proportion of dry matter was allocated to the growth of the root system under these conditions further increasing the root growth. Available phosphorus content has significantly correlated with cluster root number, root length and above ground growth of *G. robusta* L.

LEVEL OF AWARENESS AND CONSTRAINTS TO ADOPT NEW TECHNOLOGIES DETERMINING THE RETENTION OF FARMERS IN SUGARCANE CULTIVATION

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Sugarcane (*Saccharum officinarum*) is the sole crop cultivated in Sri Lanka for manufacturing of sugar since 1840s. Current production is about 52,342 tons, sufficient to meet 9.2% of the local sugar demand. Sugar imports to Sri Lanka amounted Rs 37 billion in 2013. Recent reports have indicated that the farmers are shifting away from sugarcane cultivation and the total production is on a decline. The objectives of this study were to find the level of awareness and constraints to adopt new technologies among the small-holder sugarcane growers that would affect their decisions to retain or move out of Sugarcane cultivation. The sample included 82 sugarcane farmers selected randomly from 11 Grama Niladhari divisions from the Siyabalanduwa and Buttala Secretarial Divisions in Sri Lanka. Descriptive statistics and Chi-square association tests were used for analysis.

Among respondents almost 70% of the farmers have been engaged in sugarcane farming. About 30% of the farmers have out migrated from sugar cane to Maize and Cassava cultivation. Out of the respondents, 52.4% were aware about the new techniques and technologies in sugarcane cultivation, whereas 47.6% of them did not have any awareness about new technologies in Sugarcane cultivation. Irrespective of their awareness levels, they all believed adoption of new technology would be useful in sugar cultivation. An association was revealed between farmers engaged in sugarcane cultivation and their awareness level on new technologies in Sugarcane. Limited land space seems to be a constraint for almost 42% of the farmers. Nearly 66% farmers think that adopting to new technology will increase the cost of production. Farmers with relatively large land size were aware of new techniques on sugarcane cultivation more than the once with small land areas.

The main reason for loss of interest in sugarcane cultivation was decreasing trend in profit margin. Quality seed canes (47%), Land (32%), Good price (32%) and irrigation facilities (21%) were the facilities expected by the sugarcane farmers to expand their cultivation. Labor requirement, non-availability of materials and technical guidance, lack of co-operation from sugar factory and technical staff are not considered as constraint to sugarcane farmers but higher cost involved in adopting new technology is considered to be a constraint. If these facilities and newer technology could be accessed by farmers at a lower cost, adoption to new technology and farmer retention would not be a problem in the sugarcane industry.

THE VALUE OF FRIENDSHIP IN ARISTOTLE'S *NICOMACHEAN ETHICS*

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The *Nicomachean Ethics* of Aristotle was a collection of lecture notes prepared by Aristotle to instruct his students in his school known as Lyceum. These notes were posthumously collected and edited for publication by his son Nicomachus. The text contains ten chapters and the majority deals with virtues or moral values. The entire book as a whole is about ethics as the title itself describes. The text deals with intellectual, moral and social ethics and this is the only work Aristotle has compiled on social ethics. The themes of the chapters such as moral virtues, intellectual virtues, continence and incontinence, justice and friendship instruct the followers to lead a happy life. The goal of the instructions appears to be to achieve the supreme happiness, *eudaimonia*. First, one needs to concentrate on moral virtues, and mastering it will enable one to elevate his/her thinking to the highest level of spiritual happiness (*eudaimonia*).

The objective of the present study is to examine the value Aristotle has attached to *philia*, generally translated to English as 'friendship', but is a blanket term encapsulating a range of meanings such as 'friendship', 'relationship' and so on, in achieving his goal - *eudaimonia* or the supreme happiness - in his instructions on social ethics. Similar traits can be seen in the terms such as *philein* and *philos*, the derivatives of the term *philia* as they too engulf a wide range of meanings. For instance, the verb *philein* could refer to all associations including 'to love' while the noun *philos* could denote a range of individuals from friends, immediate family members to shop keepers. The present study is a pure library research and will closely examine both Primary and secondary sources. Accordingly, *Nicomachean Ethics* and *Eudamean Ethics* will be studied both in original language and in translations, while various books and articles that studied various aspects of Aristotle's *Nicomachean Ethics* and on the theme of friendship will be used analytically for this study.

Out of the ten chapters in the *Nicomachean Ethics* Aristotle only devotes the two chapters before last (eighth and ninth) to discuss *philia*. When he begins his views on *philia* stating that it is a virtue, his readers or listeners were expected to know what Aristotle meant by 'virtue'. The former chapters in the text which discuss on moral and intellectual virtues are required for a better understanding of Aristotle's views on *philia*. Since Aristotle perceived men to be social animals, they cannot completely break away from the society in the course of their lives. Accordingly, through the study on *philia*, Aristotle first focuses on the entire society. Then Aristotle progressively narrows down his focus to a close circle of friends and then to one's own self. His discussion on moral virtues, mean condition, justice, continence and incontinence are directly relevant to one's associations with the members of the society which can be broadly encapsulated by the terms *philia* and *philo*i respectively. The intellectual virtues and the final objective of one's life, *Eudaimonia*, is directly relevant to one's own self. But, without the gradual progression of moral virtue, i.e. dealing with others, it is impossible to hit at the intellectual virtue which concentrates on the spiritual aspect of one's self and through which one could achieve *Eudaimonia*. It is therefore very clear that the discussion of *philia* ('friendship') is the central focus of Aristotle's *Nicomachean Ethics* as through good *philia* ('friendship') one could be directed to achieve the goal *Eudaimonia* ('extreme happiness'). The chapters on moral virtues and related affairs that appear prior to the discussion on *Philia* have formed the basis to grasp this central point in his *Nicomachean Ethics*.

TEACHERS' CODE-SWITCHING IN ESL (ENGLISH AS A SECOND LANGUAGE) CLASSROOM DISCOURSE

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Code-switching is a common linguistic behaviour in bilingual/multilingual contexts, which refers to the alternation between two or more languages in the context of a single conversation. The prime objective of this paper was to explore how code-switching is employed in teachers' discourse in ESL (English as a Second Language) classrooms. In order to gather data for this research, classroom observations were carried out for twenty teaching hours in a selected school in Seeduwa. In addition, semi-structured interviews were conducted with the respective teachers to discern their perceptions of code-switching. It was disclosed that teachers engaged in code-switching in ESL classrooms to perform the following functions: to ensure clear and quick understanding by students, show empathy and bring students back to their comfort zone. Accordingly, teachers need to adopt a strategic approach to practise code-switching as an integral component of language pedagogy. Even though speakers in their daily discourse have the propensity to diffuse code-switching arbitrarily, teachers' code-switching in ESL classroom discourse should be controlled and/or conscious. On the other hand, parallel translation should be endorsed as a teaching technique since dense code-switching may hamper students' exposure to the English language. Finally, the implications of this research warrant investigating students' viewpoint of teachers' code-switching in ESL classroom discourse.

Not Presented

REPRESENTATION OF WOMEN IN THE LYRICS OF BHUPEN HAZARIKA

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This Paper is an attempt to look into the lyrics often loaded with gender as reflected in the lyrics of cultural icon of Assam, India, Bhupen Hazarika. The proposed framework of study shall examine his songs in the context of gender. Bhupen Hazarika's name and music have a ubiquitous presence in Assamese households. Contemporary Assamese music is said to have achieved its peak through the melodious voice and dexterous hands of Bhupen Hazarika. This paper initially proposes to examine the ways how woman is an embodiment of mother earth, how his lyrics celebrate romance and desire and how the body of a woman is objectified. The image and representation of woman in music has long been a subject of concern. It has been seen that there are very few males than females as the subject matter in almost all forms of music. The relationship of woman with nature, the physical beauty and mysterious nature of woman, woman's image as illustrated with mother earth or the concept of *Dharti Mata Or Dharitri Aai* (meaning mother earth) and man's portrayal as a wage earner, protecting and safe guarding his family and nation, his active participation in revolt have most often been the theme of music. If music is often deliberately implicated in debates about gender, then it is inevitably thereby implicated in debates about how discourse transpositions (from 'gender' in law, biology, popular psychology to 'gender' in music) is possible. Using Hazarika's lyrics as locus of attention we would like to access how women in various contexts like personifying nation as mother, celebration of romantic love and objectifying woman's body are visualized through the lens of his lyrics. Here light is thrown how Hazarika's lyrics depicted a picture of these entire segments.

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APPLICATION OF A GAME THEORY METHOD FOR LIBRARY COOPERATION

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Game theory which can be described as strategy theory or theory of interactive decision-making is concerned with how rational individuals make decisions when they are mutually interdependent. The outcome of a game depends on the player him or herself, as well as other players. This research paper explores the application of game theory in library cooperation by developing a systemic method to identify different individual coalitions of a “network” based on the study of Cohen and Vijverberg (1980). A “network” is defined as a coalition (group) of libraries working together for their mutual benefit. The participating libraries will be satisfied in a network only if they cannot obtain a higher individual benefit by joining another network. If at least one library decides to leave the group then the network will breakup. Libraries should make the decision whether or not they should join a coalition and which coalition should be chosen. This paper presents the variety of choices open to an individual library when cooperating with other libraries. Specifically the situation when four libraries are cooperating is analyzed. This paper studies the concept of “division” which suggests that instead of comparing coalitions, divisions should be compared in selecting the most advantageous method to cooperate. Further studies could be carried out concerning the “stability” of a network. Library cooperation is not widely used among Sri Lankan libraries but cooperation is certainly beneficial, especially in sharing resources with each other. This research paper provides a game theory approach to help libraries make decisions concerning library cooperation.

A HISTORICAL STUDY OF SOCIAL INFORMATION REVEALED THROUGH *HATAN KAVYA*

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Hatan kavya is a special kind of poetry written in order to praise the detail of a war. It is a praise of the particular war and also the leader of the war hero. The word '*hatana*' gives the meaning of "war" and in addition it was used for different meanings such as eulogy, praise, laudatory song, information, details and danger. *Hatan kavya* bears a form of heroic poetry and it can be divided into two categories. Some are based on true historical events such as *Seethavaka hatana*, *Rajasiha hatana*, *Maha hatana* and *Ingreesi hatana*. Some are based on social incidents, commotions; satirical stories namely *Guru hatana*, *Weda hatana*, *Nalu hatana*, *Gama hatana* and *Panu hatana* etc. The second category has a literature value but it is difficult to consider that there is a historical value. Therefore, it is expected investigate facts contained in true *hatan kavya*. Which were based on historically important wars? It is also expected to study how these *hatan kavya* can be used as a primary source? Were these merely a piece of literature? And also to investigate the details of the society unveil when studying these *hatan kavya*.

It is expected to investigation the facts using research methodology related to the subject history and to investigate the primary and secondary sources, and to obtain the required information using related documents, articles and journals.

Some of the noteworthy studies done by Mullapitiye K.H.De. Silva, Ellepola H.M. Somarathne, Abaya Ariyasinghe, Venerable Abagaspiye Wimala thero are important among the studies that have been undertaken so far about *hatan kavya*. In addition to that, a number of scholars have also conducted various researches on the topic in question.

By carrying out research in this manner, a lot of information on Sri Lanka's Social history can be unearthed. The accepted point of view of critics of all over the world is through a literature work contemporary life of people and society is interpreted. Accordingly, *hatan kavya* confirms this idea. They can be considered as a mere literature work to obtain some useful information but also as a historical source through which history of the society of 15th to 19th century can be obtained. The information not only wars of post medieval period, fighting methods such as *guwarilla* and local army consisted of Sinhala, Tamil, *Pallawa* and *Malay* people and declared wars according to customs and traditions, first camping, firing gunshots, hoisting while flags, blowing of conches, starting the war at an auspicious time and march forward for the war, to escort Vedas or haunTERS and dancers, the orchestra also providing to the battle fields etc., also weapons of the contemporary period such as bows, spears, crowbars, clubs or truncheons etc. a lot of information could be derived from *hatan kavya*. In addition designations, services of the officers of *kotte*, *seethavaka* and *senkadagala* and also 32 methods of punishments prevailed during that period, economy, decentralized administration under the leaderships of the king and titles such "*hamuduruvo*, *deviyo*, *nirindu*, *narapathi*, *deranapathi*, *deepa sakvithi* and *mahipala* etc. from which the king was addressed by people can be obtained. Other information unearthed through those *hatan kavya* was the lives of contemporary peasants' faiths, local customs and traditions and beliefs can be obtained. Furthermore they are of immense assistance to confirm the records available elsewhere and also come to know about some information which was not mentioned in sources such as *wansakatha*. But according to the eulogistic style of writing of this form of literature, the information contained thoroughly and through this procedure to establish a true and correct history.

A SOCIO LEGAL STUDY ON HARASSMENT FACED BY WOMEN IN PUBLIC BUSES

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Sri Lanka is a prominent country, which is providing infrastructure facilities such as public transport services, highway, electricity, housing schemes etc., among other developing countries. Out of these infrastructure facilities the public bus transport service is used by the 99% people of the country. Majority of women become pabulum in mentally, physically and verbally from their heterosexuals and other disturbances when they are using public bus transport services. This study attempts to reveal about the security of women while they are using public bus transport service in Sri Lanka. To identify the legal frame work that can be implemented for the security of women who are having public bus transport service in Sri Lankan society was the main necessity of this study. To gain knowledge about the passenger's rights, to identify the legal actions what can be taken against the harassments happening in a bus and identify the nature of the harassments which women is facing in a bus were the objectives and the Survey method was the main research methodology of this study. Participation observation, interviews and questioners were the data collecting techniques. According to the research findings 62% of women who used PBTS¹ in Sri Lanka have been facing various types of harassments such as verbally insult, travelling in heavy crowded and with noisy songs bus, showing sexual organs, none giving of balance etc... But no one has gone for the legal actions for their injustice. Majority of the women, age between 16 – 35 are physically victimized by their heterosexuals. When considering of the National Transport commission Act in 1991 as a passenger, women has the right to travel safely up to the destination to which the fee was paid for. Sometimes the pregnant women may not have a seat. No one is to offer a seat. It is deprived of their rights and safety. Considering about the verbal insulations, Passenger should receive courteous, welcoming service by a well mannered, smartly and decently clad bus conductor and driver. According to the above listed harassments the high value is taken by the exceeding approved volume of radios there are some limitation to play video and radios inside the bus. Passenger has the right to travel in a bus, which if using a radio, should use it to a maximum volume of 80 decibels only. According to this kind of facts, in present society women do not have a considerable security while they are travelling in a bus. The research findings show that exceeding approved number of passengers taking in to bus is caused to lot of harassment what are the happening in public bus services. To overcome this kind of circumstance there should be a strong legal foundation and the precepts what have been imposed in present should be updated. Like that all passengers should know their rights and persons should have a self discipline when they are in public places. When citizens are aware of the above legal and social background which is affected for this kind of harassments, it will help to buildup legally and culturally enriched Society.

SPORTS JOURNALISM: SPORTS REPORTING OF WOMEN ATHLETES IN VIRAKESARI NEWS PAPER

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Sports serves as a hegemonic institution that preserves the power of men over women and mass media assists in maintaining sport as a masculine hegemonic domain. The existing literature indicates women's sports are extra ordinarily underreported.

This study is being carried out to examine the coverage devoted to women athletes in Virakesari Tamil daily newspaper from October 2013 to December 2013. The quantitative data collected through content analysis were further analyzed using qualitative approaches.

The results indicate that Virakesari newspaper consisted 76% of men- only stories and 6% of women- only stories. Overall results demonstrates that Virakesari newspaper is giving a low coverage for women athletes and the coverage of the women's sports reflects the dominant belief about gender in society that females are unimportant in public events.

GOOD GOVERNANCE AND PUBLIC OPINION: A CASE STUDY IN SELECTED SUB URBAN AREAS IN WESTERN PROVINCE

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Recently the terms ‘governance’ and ‘good governance’ are being increasingly used in Sri Lanka especially in and after the presidential election 2015. In general the concept of good governance has 8 major characteristics. It is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. In order to achieve goals of good governance it needs some other conditions which are interrelated with the concept such as: developed political culture, democratic values, qualitative policy making procedure and respect for human rights.

Often governance issues arise when one is uncertain about what the entity is one is dealing with, such as in a network, across a service continuum or when services are delivered through a partnership or contract arrangement. Therefore, it is important to make a public understanding what the entity is and who is accountable, and what the entity concern should be legally constituted, aware of its responsibilities and easy to identify. In this context the research centered in to following research question; “Even though the concept of ‘good governance’ is recently being used by various parties in the society in day-to-day life, how does the general public get understand and accurately apply this concept in their real life?”

Methodology of this research is based on three aspects: a) library research b) questionnaire c) in-depth interviews. Both primary and secondary data were used in this research and primary data were collected by using questionnaire, in – depth interviews and observation. This study was limited to three electorates: Negombo, Maharagama and Horana in order to cover all three districts in the Western Province. Secondary data were collected by means of library research, academic journals, web sites, research papers and articles.

The key finding of this research was a majority of respondents (about 70%) were not aware of the concept of ‘governance’ and ‘good governance’ or its practices. Over 50% of the respondents seem to use good governance merely as a word. It was reveal that politicians, media, academics and civil society organizations have greater responsibility in making comprehensible the common public on good governance.

Not Presented

A COMPARISON OF REFERENCING PATTERNS OF SOCIOLOGY AND ECONOMICS SCHOLARS IN UNIVERSITY OF PERADENIYA, SRI LANKA: A CITATION ANALYSIS OF POSTGRADUATE THESES

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Citation analysis is one of the popular methods employed in recent years for identification of core documents and complex relationship between citing and cited documents for a particular scientific community in a geographical proximity. The main objective of the present study is to investigate the citation pattern of sociology and economics scholars at University of Peradeniya through their postgraduate theses. In order to achieve the research objective, 32 postgraduate theses of sociology (14) and economics (18) submitted from 1996 to 2014, which are at the Main library, University of Peradeniya were selected. The citations extracted from the title pages and reference lists of each of the thesis and dissertation were analysed using SPSS package (16.0 version) to examine their reference pattern in relation to format of document, the chronological distribution, research collaboration and the authorship pattern of cited documents.

The results indicated that 57.8 % of citations in the sociology theses were books followed by 48.7% in economic theses and 22.2% and 25.7% of citations were journals respectively. With regard to the format of the information sources, most of the citations in both sociology (94%) and economics (97%) theses were in print format. With regard to the chronological distribution, 90.8% of citations in sociology theses were recorded from 1951-2000 whereas 91.1% of citations in economics theses were recorded from 1971-2010. The results further revealed that the English language predominates in both sociology (87.6%) and economics (88.7%) theses while single authorship predominates in both sociology (81.9%) and economics (63.6%) theses whereas 32.8% of citations had two authors in economics theses. The degree of collaboration in the field of sociology is 0.18 whereas the degree of collaboration of the economics is 0.36 which prove less collaborative work in sociology than in economics. With regard to the geographical distribution of journal citations, it was found that foreign journals dominated in both sociology (72.7%) and economics (79.3%) theses.

The study concluded that both sociology and economics theses references contained books than journals and other formats and the English language is predominated in both disciplines. It is established that economics scholars cited more recent publications than sociology scholars and all scholars preferred to use printed formats than electronic formats. The single authorship appeared most in the citations of both sociology and economics and the study found that less collaborative work in sociology than in economics. Further study of citation pattern in other social science disciplines would be suggested. Understanding the citation behavior of sociology and economics scholars will help librarians to make decisions on library collection development.

DECENT STATUS FOR LOCAL WOMEN DOMESTIC WORKERS BY EFFECTIVE APPLICATION OF LAW

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There are several dialogues in Sri Lankan society on migrant female domestic workers, but a rare attention goes to local female domestic workers. People resort to domestic works for various reasons and under various circumstances. However, the increasing trend of the domestic workers in a country is also an indication of inefficient social protection system. This study significantly emphasized the necessity of decent works for local women domestic workers. Moreover, in countries like Sri Lanka, progressive and peaceful development links with the qualities of people's lives. In order to achieve that progressive development, it is very important to pay consideration on these marginalized groups.

This piece of study is a combination of qualitative and quantitative methods. Here, qualitative analysis explored more insights of the social issues of local women domestic workers plus quantitative method used to focus on the responses of population in a statistical aspect. As a result, this combination created a good quality research.

As found in the research, most of the legal specialists agreed that domestic work is performed outside the realm of labour regulations. Some of them highlighted the utility of Penal Code and Human Rights laws with pertaining to the social protection of domestic workers. However, according to them, there is no specific labour law in Sri Lanka to provide safe and healthy working environment for domestic workers, but the officers who represent the Labour Commission disinclined to accept the vulnerability of local domestic workers before the law. When we come to the responses of domestic workers, their responses can be generalized under one umbrella, because they articulated the same frustrations and sufferings in different ways. As local women domestic workers experienced, there is no one in Sri Lanka to provide them social security coverage like pensions, disability and survivor insurance, overtime payments, EPF and ETF etc. Hence, it is obvious that they are thirsty for those rights even though they are not interested on a specific law to safeguard them.

According to my view, a newly drafted legislation is needed to bring to the arena, because local women domestic workers are illiterate, vulnerable and seemingly without collective power to achieve their working rights. Therefore, a blended law of domestic workers experiences and legal specialists' knowledge will efficiently contribute to develop social dialogues on them, control class biases, address their issues and establish a true relationship between master and servant. To accomplish above goals new laws ought to include fundamentals like conditions of employment, nature of work, rest periods, paid holidays, sick leaves, maternity leaves and living wages with adhere to International Labour Organization standards. On the whole, this study can be identified as a piece of work which respectfully submits that a "Just and Free Society" ("*Dharmista Nivahal Samajayak*") can be achieved for local women domestic workers through an effective application of law.

RATHUPASWALA TV NARRATIONS: AN ANALYSIS OF MEDIA CONTENT

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The object of this study is to examine through the media content of the television taken as a sample to prove whether the abundance of media establishments in a country leads to the offer of a pluralistic media content to the subscriber.

What stirred up our attention was the reconstruction or non-reconstruction of the news broadcast in the course of 10 days, i.e. from 27.07.2013 to 05.08.2013, by 6 television channels, i.e. *Sirasa*, *Swarnavāhini*, *Hiru*, *Derana*, ITN and the National TV, pertaining to an outcry demonstrated by the residents of some 12 *Grama Niladhāri* Divisions, i.e. *Ratupaswala*, *Nadungamuwa*, *Imbulgoda*, *Wāliwēriya*, *Ambaraluwa*, and *Galoluwa* in *Gampaha* Divisional Secretariat, in *Gampaha* District relating to the issue of water pollution that affected them. During the period of these 10 days airtime allotted to their leading news broadcast by these channels were *Sirasa* 47 minutes, *Swarnavāhini* 40 minutes, *Hiru* 36 minutes, *Derana* 34 minutes, ITN 15 minutes, and the National TV 12 minutes. It was only *Sirasa* which reported the incident in question throughout the whole period of 10 days. Further, *Sirasa* on 29.07.2013 and *Hiru* on 30.07.2013 broadcast a special report based on fieldwork. The most serious clamour took place involving the death of 3 civilians on 01.08.2013 and it was then that ITN and the National TV broadcast reports about the incident. Both these media houses are state-owned and they devote their airtime as to prove that the armed attack was reasonable. None of these channels publicize sufficient amount of information on the part of the factory. Channel *Derana* allots a little airtime to the management of the factory on 02.08. According to these data the following observations could be drawn. Namely, state-owned media establishments are not sensitive to this kind of problems of the common man. Priority is given by them only to broadcast of various state programmes. The state media does not broadcast any public opinions and visual images pertaining to this incident. It is the private media which pays attention to the affairs of the public and interferes with them. None of these media makes an investigation into incidents beyond mere reporting. All the media in accordance with their own whims and fancies create a hero and a villain in their news broadcast. None of these media go beyond dialectic dimension. We can arrive at the following conclusion relevant to our theoretical issue on the basis of these observations. Namely, dualism of the media or multiplication of channels also has had an influence on dualistic differences in the media content only if the state-owned media is compared with the private sector. None of these channels manifest a multi-dimensional exploratory use of the media.

RELATIONSHIP BETWEEN CHILD'S BIRTH WEIGHT AND SOCIO ECONOMIC STATUS OF PARENTS: THE CASE OF USA

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Birth weight is steadily associated with mortality risk during the early infant age and parents socio economic back ground. Also known to associate with developmental problems occur in childhood. The objective of this study was to identify the relationship between birth weight and selected explanatory socio-economic variables such as father's age, mother's age, mother's education, mother's cigarette smoking and drinking alcohol during pregnancy, five minute medical test in pregnancy period, and having a male baby.

This study was conducted using secondary data of 1832 observations to identify the factors determinant to single live birth weight in United States. The all diagnostic tests carried out relate to cross-sectional data analysis, and used STATA statistical software for the data analysis.

The results showed significant relation-ship between birth weight, and five minute medical test in pregnancy period and mother's cigarette smoking during pregnancy. When spending more time on medical test leads to increase in birth weight and increasingly smoking leads to decrease in birth weight. Further it provoked that birth weight has a positive relationship with the gender of the baby mainly a male baby. There were no relationships between father's age, mother's age and her education, and alcohol consumption of mother during pregnancy to birth weight.

Cigarette smoking during pregnancy is positively associated with low birth weight. Gender of child also had a relationship with birth weight. The paper concluded that United States government should consider appropriate preconscous measures to lessen the effect of these socio-economic factors to birth weight. Further, research is needed to identify the similarities within Sri Lanka.

Not Presented

POPULARITY AND COMPLEXITIES OF SINHALESE TEMPERANCE LITERATURE IN 1904

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Although the first temperance movement of 1904 in Sri Lanka was political in nature, it produced a considerable contribution of literature. Numbers of books, pamphlets, journals and poetic papers were published and distributed among the public to promote temperance ideology. Those texts manifested in different, well-known literary forms, but the ultimate objective was realizing a totally abstinent society.

The styles of “message poem” (*Sandesh*), “war poem” (*Hatan*), “play” (*Nāṭya*), “devil dance” (*Thovil*) and “catechism” were common themes employed by authors in writing temperance texts. These authors came from different social backgrounds—some were Buddhist and Christian clergy, others were lay temperance leaders, journalists and non-elite poets. The greatest number of books was published from June to October 1904, a period in which temperance activities reached a climax. These books were predominantly published by Buddhist presses, extending from 6 to 42 pages. Where some books include a picture of the leader of the temperance movement, they contain a note of the cruelty, drunkenness, and barbarism of an anthropomorphized alcohol demon (*Sura Yaka*), serving to promulgate temperance ideology. 2000 to 8000 copies of each book were published, and some were ultimately printed in a second edition. Meanwhile, other misleading books that depicted an outward appearance of temperance but lacked substantive temperance content were also published. The publishing of fake books involving plagiarism emerged because of the popularity of the original texts. Indeed, the production of temperance books was an effective way to earn money during the period of temperance agitation. This research attempts to analyze these facts in manifold ways with necessary criticism.

Not Presented

TEEN CULTURE; A PRODUCTION OF MODERN POPULAR TELEVISION AND NEW MEDIA TEXTS

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Objective of this study is to read the psychic and physical consequences of the teen culture. As the modern television and on-line forms of media are much concentrated on the plethora of highly entertainment texts in a very popular passion, this study assumes that the modern social and physical behavior of the teen has been largely shaped by the popular commercial entertainment programs of the television and on-line media. The way how teens imitate and behave their day today gestures and postures including their hairstyles, cloths and all the fashions are reflected the dignified association and influence of the mass media and on-line media forms. As a result of this widespread behavior projecting from the popular spectacle of the media, teens are impossible to make their identity and personality in response with their societal challenges and living consequences. One of the best examples for showcasing that media inject a high dose ill effects is that the teen's inability to understand that they are cultivated and shaped by the media saturated environment. Value system and their variety of needs and interests are formed and created by the television entertainment programs (Mega-drama, reality programs, advertisements, Musical programs). On the other, cultural and political opinion and beliefs are also transformed by the social media networking (FB, Twitter, and blogs). Moral and normative functions related to love and sexuality are also largely constructed by the social media and other forms of on-line media. This study concludes that total transformation of the teen culture is happened by the overwhelmingly used television and new media. Finally this study suggests that the literacy of media which promote the ability to critically understand the nature and effects of entertainment and commercial media texts, should be enhanced through the media education and other awareness programs for the teens for saving them from engulfed dangers of mental stress, depression, suicide and other psychosomatic disorders as well as deceptive myths.

INSTITUTIONAL CHALLENGES FOR SUSTAINING MASS MEDIA AUTONOMY IN SRI LANKA

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Mass media is one of the strong channels, which provides information in order to make the public informed of socio-cultural and politico-economic changes at local as well as international arenas. People become awareness and grasp the correct information through the mass media. Like the legislature, executive and judiciary play a very important role as methodical institutions to conduct the government in any country; it is not very simple service, which the mass media provides as an informal institution. Anyhow the mass media performs a very important task to organize the people's opinion. Mass media is the main channel to provide information to the public. Mass media has become the main method, which expose the errors that happen in the country. Because of these exposures, the influences aimed towards the mass media are supreme. While the influence made to the mass media can be categorized as political and institutional, the political influence can be recognized very easily in the modern social process but it has been very difficult to recognize the influence made as institutional. Therefore, as the poser of this research, the matter of what are the institutional challenges, which influence for the mass media autonomy in Sri Lanka? was considered and conducted researches and as the main objective of this research was to inspect the institutional disturbances which are available for the mass media in Sri Lanka and as the sub-objective, recognize the operation of mass media in Sri Lanka and inspect the attitude towards the mass media by the government, can be indicated. Primary and secondary data was used for the performance of this research and as the boundaries of these research limitations by assignment, accuracy when obtaining information under the primary sources and had to face the problems such as loyalty. As the result of this research, making influences to newspaper journalists and reporters by owners of mass media and newspaper editors, and accordingly as the conclusion of this research of the mass media is a conception and it is a situation, which can be seen in the country. When a newspaper is also considered the discretion of the said editor of that newspaper has to be taken in to account. And that editor has to take the discretions of the owners of that institute and heads of the management into account. Because of these limitations avail inside the institute, the availing autonomy for the mass media has been blocked. This can be indicated that the said situation has been directly influenced the existence in a democratic society.

FORMULATING A NEW LEGAL MODEL TO ADDRESS THE DEFICIENCIES OF THE VEHICLE EMISSION TESTING PROCEDURE TO MAINTAIN A BETTER AIR QUALITY IN SRI LANKA

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The research was designed on the hypothesis that “the ultimate goal of introducing laws regarding emission test in Sri Lanka has been not achieved yet”. The purpose of the research was to identify whether the law on emission test is enforced properly to achieve its goals, to identify the deficiencies when it is practiced in reality and to propose a new model to overcome the practical issues. Law on emission test was introduced to Sri Lanka by the Motor Traffic (Vehicle Emission Control and Certification) Regulations of 2008. Jurisprudential goal that was intended to achieve by introducing this Regulation was to protect the natural environment by maintaining the air quality with the perspective that no person should be allowed to do anything which is detrimental to the health, welfare, safety of human beings, harmful to animals, birds, wildlife, plant or all other forms of life or detrimental to any beneficial use of atmosphere. This could be achieved when the law is implemented properly by the institutions involved. Methodology used for the research was a collection of three methods; quantitative, qualitative and participatory observation. Institutions which are related practically to enforce the law on emission test as well as the general public were participated in the research. With the implementation of the Law on Emission Test, vehicles are tested for its compatibility in relation to standards set out on emissions when the revenue license was issued annually. Despite this positive development, vehicular air pollution has not come to an end due to various deficiencies in the procedure. Most of the deficiencies are rooted from the lack of a proper monitoring procedure. Emission Testing Centers are managed usually by private companies who concentrate more on profits than their social service. Governmental authorities to whom the power is delegated to achieve the goal of law do not have a proper monitoring procedure to monitor these Emission Testing Centers. This gap is filled with fraudulent practices. People without any hesitation accept the fact that they engage in these fraudulent practices owing to the negative features of the procedure like time consuming and lack of trustworthiness. Participatory observations revealed that all the complains people made were true. Transparency is no where found in the procedure. Emission Testing Centers were reluctant to give out the information. Further there is no clear practice or policy regarding governmental vehicles especially trains. A bulk of powers in the procedure were vested on the Motor Traffic Commission *inter alia* other powers. Various institutions are named in the procedure but with no identifiable co-ordination or interconnection. Lack of progress measuring researches is also problematic. Identifying these deficiencies, the research proposes a new model of emission testing to achieve its jurisprudential goal in a people friendly manner.

COLOUR PERCEPTION AND INFLUENCE IN FASHION

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Perception is a scientific process by which people learn and get ideas about the environment. Modalities of perception are vision, hearing, tactile sensation, taste and vibration sensation. People are influenced by certain fashion along with said modalities. Culture (norms and values), level of communication, accepted colours are the significant factors that involve in perception of a society. Colour is a factor which related to visual perception of a person. An attempt has been taken to investigate and analyze how socially accepted colours affected process of influence in fashion. The analysis is explored through actual descriptions made by observational - participants, historical records, murals of the period. The analysis was explored through historical records, murals of the period and reviewing literature. Again, the analysis was surveyed through socio-cultural, administrative, religious and economic factors of the era. These factors were again analyzed with foreign influences to understand the theoretical base on influence fashion. This has resulted in developing several theories to explain how such statuses were instrumental in bringing about in influence in fashion.

The selected study setting is Kandyan era (16th century -1815) of Sri Lanka. During its reign time the Kingdom was heavily influenced by Western and Eastern foreign influences. These influences has caused huge impact on Sri Lankan dress in every aspect like novel dress items, silhouette, accessories, headdress, dress materials, colours. Colour had been a successful stimulus in influencing foreign attire as well as an inhibitor during Kandyan reign. Colour perception was bound thoroughly with traditional values and norms during the Kandyan kingdom. During Kandyan era limited colours were used in dresses. Red, blue, yellow, green and white were mostly used. As result of the factors of availability, durability and the cost, each colour was given characteristic value and symbolic meaning. Colour was a symbol of social status, dignity, power, wealth. White shows equality, piece and purity. Black was un-interested colour in Sinhalese dress styles. According to Sinhalese culture black depicted demons, bad spirits, sin and misery. Some historical events described how Sinhalese people were gradually influenced by black dresses. Yellow is bound to Buddhist and Hindu religion and have been practised from the time immemorial. The yellow was considered as a sacred colour and unacceptable to be worn by people other than spiritual personalities.

According to the historical exploration on colour perception, it was found that people perceive colour in a common way although there are some differences in perception at individual level. As a community people had common perception of values and norms of certain colour and that was cleared through common ceremonies like temple, funeral and marriage ceremonies. Perception of colour is unique to individual cultures.

Not Presented

SOCIAL REALISM IN JAISHANKAR PRASAD'S 'DHRUVASVAMINI'

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With the influence of the Industrial Revolution at the end of 18th century Realism enhanced by the ideas of Karl Marx, Charles Darwin, and Sigmund Freud became a trend in western literature. The concept of Realism came to Hindi Literature after the establishment of the 'All India Progressive Writers Association' under the auspices of the great Indian writer Premchand in 1936. Jaishankar Prasad is a writer who belongs to the *Chhayavad Yug* (Romantic Period: 1920-1936) of Hindi literature. In 1933 he wrote a remarkable romantic and historic play called '*Dhruvasvamini*' (*ध्रुवस्वामिनी*) which is significant among *Chhayavad* dramas. This paper attempts to examine the Social Realism in Prasad's drama. The objectives of this research are to analyze how and where Prasad has used concept of Realism in the play *Dhruvasvamini*. The results of this research contribute to our understanding of Realism in Hindi drama as well as Jaishankar Prasad's contribution to this endeavor. This study also highlights the existence of realistic elements which was a novel concept to Romantic period of Hindi literature.

GOVERNING URBAN POOR: A CRITIQUE ON THE DISCOURSE OF SLUM FREE CITY IN COLOMBO, SRI LANKA

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After the end of the war in 2009, the government of Sri Lanka embarked on high-rise housing projects driven by the discourse of slum free city in order to resettle approximately 68,000 low-income families in Colombo with the notion of upgrading living standards of the urban poor. Accordingly, the government planned to construct 14 housing schemes and few of them were completed. In this background, focusing the post-development perspective, this study argues that the state has used the discourse of upgrading living standards as a mechanism to govern the urban poor and urban space. The objective of this study is twofold: to explore the governing methods applied by the state and consequences of governing on the urban poor. The analysis is carried out through data collected from 30 re-settlers of *Mihindusenpura* high-rise housing project in Colombo. Convenient sampling technique was used to select the respondents for the study. This study employs a range of primary and secondary data sources; observations, key informants, semi-structured interviews and UDA reports on slum resettlement project.

The findings of the study reveal that the state has adopted various governing methods with broader two objectives; to control deviant behaviors that take place in the housing scheme and to maintain the beauty of the housing scheme. Since the slum community is stereotyped as a breeding place of drug dealing, prostitution and crime, the state has used a series of governing methods such as use of retired army persons for housing administration, establishment of a police post in the housing scheme, use of security persons at the gate, police mobile visits to the housing scheme in the night, use of personal contacts to receive information towards deviant behaviors occur in the housing scheme to control such issues. Particularly the housing administration followed a range of strict rules and regulations to maintain the beauty of the housing scheme. Both governing mechanisms serve the state to closely supervise and monitor the behavior of the urban poor as well as the urban space, and it has impacted on the day-to-day lives, freedom and the privacy of the urban poor. The study concludes that the urban poor have become victims of the neoliberal discourse of slum free city.

A STUDY OF THE REGRESSIVENESS OF DRUG PREVENTION IN SRI LANKA

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This study is limited only for arrack and cigarette. Preserving of the teetotalers' continuity, suppressing of the rare users' tendency and gradual rescuing of the addicts' lives are the occurrences expected through drug prevention. Many governmental and non governmental institutions for drug prevention conduct functions such as drug prevention, control, raid, counseling, taxation and advising authorities to pass suitable rules and regulations. This study causes to identify a few institutions for drug prevention in Sri Lanka. Their functions, emerged problems and constraints against the success are also disclosed simply.

The study had our objectives: identifying a few governmental and nongovernmental institutions for direct or indirect practice on drug prevention, identifying their roles simply, identifying some problems facing such institutions when engage in drug prevention. and the identification of some facts which slow down the success of the results though there are many organizations and institutions for drug prevention.

Survey method was used to collect qualitative data. Sample consists of 25 teacher trainees from four National Colleges of Education and 10 active workers in drug prevention. Open interview and Questionnaire had been used as research tools for collect data and primary and secondary sources also used and data were analyzed qualitatively.

Some governmental and nongovernmental institutions and their roles for drug prevention in Sri Lanka had been identified such as Police Narcotic Bureau, Department of Excise, and NDDCB/ etc. The Police Narcotic Bureau engages in drug prevention, control, raids and advising other police stations. Taxation, holding drug prevention programmes and doing raids are done by the department of excise as well. Rehabilitation, control and advising the government to enact the laws are done by NDDCB. The NATA engage in drug prevention advises the government to enact the laws and leads some raids. Sri Lanka customs is directing raids too. As some nongovernmental institutions, SLTA, ADIC, TYOS, Sarwodaya, TYC, Sri Lanka Sumithrayo, FONGOADA conduct programmes on drug prevention and awareness. Problems which governmental and nongovernmental institutions faced had been identified as the 1st goes for lack of resources. Attitudes of the officials as well as deceptions, objective verities, foreign influence, corruptions, unnecessary mediation of politicians and higher officers were identified as problems and all those problems lead to low success of the results of drug prevention. Weaknesses to select the most suitable target group are another important matter. Additionally liquor and cigarette companies touch a young target group for their promotions and these institutions also should have to touch for their purposes.

In conclusion fruitful results can be achieved if all the organizations that works so as to exterminate drugs together and work with a common objective. Also, modern technological methods should be used to prevent drug menace. Active people should have positive attitudes and they should promote their positive attitudes on drug preventing. They should work so as to win the trust of the people. They should be tactful when they select target groups for drug prevention. It will be more successful if the drug preventing companies select their target groups for drug preventing programs according to the target groups selected by the drug companies. It is very important to form a National drug prevention policy to be followed by all institutions.

NOTIONAL PRESUMPTION AND TRAVEL WRITING: AN ANALYSIS OF THE TRAVEL ACCOUNT OF JEAN – BAPTIST TAVERNIER

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Travel writing focuses on some preconceived notion, as Lewis Strauss rightly commented, “Travel books have preserved the illusion of something which no longer exists.” Certain stereotypical ideas have been ascribed to the travel accounts. It can be seen as a conscious attempt to label the visiting place as the ‘Other’. The concept of labelling the ‘Other’ through different aspects, such as idealization, eroticization, chronopolitics and self- criticism is visible in the writings of the travelers. The travel account is an outcome of a comparison between the notional presumption of the traveler and the reality which he/she encountered. Nevertheless, travel accounts constitute an important source for the study of the past.

Assam, though a fascinating state on a strategic frontier of India was not a popular destination in the earlier period. However, certain commercial interests and on rare occasion, a spirit of adventure led a small number of foreigners to this region. The accounts of European travellers such as Ralph Fitch, Francois Bernier, Jean Baptiste Tavernier, John Peter Wade, Jean Baptiste Chevalier, and Captain Welsh had augmented the history of Medieval Assam.

This work will focus on the travel account of Jean – Baptist Tavernier, *Travels in India*. Although he has focused on different parts of India, this paper will concentrate mainly about his vision of Assam. Jean- Baptist Tavernier explored Assam during the course of the 17th century. He procured first-hand information about Assam through his visit with Mir Jhumla during the course of the Ahom – Mughal wars. He has described various aspects of the society of Assam in his account. While analyzing the account of Tavernier, one can sense the stereotypical presence of the mentality of the travelers, which this research work intends to explore.

Not Presented

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**“ETHICAL RESPONSIBILITY” OF MEDIA IN PORTRAYING
LARGE SCALE HEALTH HAZARDS:
A STUDY OF THE PORTRAYAL OF CHRONIC KIDNEY DISEASE OF
UNCERTAIN ETIOLOGY IN LOCAL NEWSPAPERS IN SRI LANKA**

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Chronic Kidney Disease of uncertain etiology (CKDue) is one of the large scale health problems in the contemporary Sri Lankan society and it is highly prevalent in certain geographical areas in Sri Lanka. This illness situation ought to be read not merely as a health problem but also as a mass scale social problem which affects the quality of life of the patients, their families and the community as a whole. Though there is no dearth of scientific and medical studies there is a distinct lack of substantive sociological studies carried out in this field.

CKDue patients face a dual burden; they face lots of social and psychological hardships particularly due to the “mysterious” origin of the disease. In the case of multiple factors that determine identity of patients of CKDue, stigma is one of those that arbitrarily overloads or overrides many of the other factors in creating a negative attitude towards the person in a community. Since the current debate on CKDue emerged in the recent past in Sri Lanka as a development-induced disease, there is a huge media-coverage and sometimes people who are diagnosed with CKDue and those who live in CKDue-prone areas are negatively affected through the careless and often hyperbolic portrayal of the disease via media.

This paper problematizes the portrayal of CKDue in local newspapers and demands the ‘ethical responsibility’ of journalists towards people who are affected by this illness. In this qualitative study the content and the form of 63 local newspaper articles on CKDue in Sinhala newspapers such as *Silumina*, *Dinamina*, *Maubima*, *Rawaya*, *Irudina* and *Divaina* from 2012 to 2014 were analyzed using the content analysis.

Some of the news reports on this new world disease were helpful in arousing a public outcry against this menace and contributed to raise public awareness of the disease and this is important from the angle of evolving a political response, policy concerns and legislation about agro-chemicals etc. But what is disturbing in the portrayal of CKDue in local newspapers is that sometimes the reporting also has the unintended consequence of shaping public perception of the disease and patients in stereotypical ways. The most commonly visible three patterns of discriminations of CKDue patients were found through this analysis; (a) Use of stereotypes to define the “victims” or “sufferers” of CKDue as well as geographical hot spots of CKDue. (b) Use of an exaggerative diction which often creates completely a negative image of the patients as well as their families. (c) Efforts to define CKDue which stereotype CKDue patients and also complicate the current discourse of CKDue in Sri Lanka further.

Consequently, this study emphasizes the need to rethink the ethical responsibility vested on the journalist and the general public when dealing with a large scale health problem. This study recommends that there must be a strict control of information management imposed by the responsible authorities and such reports should not contain figures of speech. Also, the coping and resilience strategies of CKDue patients and their families must be reported to empower them.

A STUDY OF THE SOCIO-CULTURAL PARAMETERS ASSOCIATED WITH MEAT PURCHASING AND CONSUMPTION PATTERN: A CASE OF BANDARAWELA, SRI LANKA

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The factors affecting purchasing and consumption of meat are varied and multifaceted. The main objective of this study was to understand the factors affecting the demand and consumption of different kinds of meat by rural and urban household in the Bandarawela area. A pretested structure questionnaire was used to collect information from 150 consumers. All respondents consumed at least one kind of animal product but 18 of respondents did not consume any type of meat. Most respondents lived in semi-urban (51%), urban (32%) and rural areas (17%) areas. The gender distribution of respondents results reveal that majority of respondents were females and comparatively less males were recorded. The most preferred meat type was chicken followed by mutton, beef and pork. There was a significant association between purchasing meat and socio cultural factors (location, gender, religion, education level, occupation, income). Study finding indicate that there was a significant relationship among religion, traditional beliefs, age and buying of meat. Chi square test was given there was an association between religion and preferable meat types, additional chicken, beef, pork had significant relationship except mutton. Most of the respondents agreed to say meat is a good protein and it has a nutrition enhance source so it was conclude that the meat and meat product market in Sri Lanka should be diversified to match with the diverse preference for different meat type.

SOCIO ECONOMIC DETERMINANTS OF FARMERS' PREFERENCE TO ORGANIC AGRICULTURE

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In most developing countries, agriculture plays the major role by being the most important sector of the economy. Many farmers today feel that cultivating without using agrochemicals is not possible. But the problem is using synthetic causes many problems such as lots of health problems, soil erosion, environmental pollution and loss of biodiversity. With the development of many diseases, after consuming higher amounts of chemically treated vegetables and other food products, now mankind is looking for alternatives. The search is for more safer food with minimum chemical applications. To supply to this demand, farmers and growers have also have shifted to organic agriculture while fetching very high prices. As in other developing countries Sri Lanka has also identified the potential of organic products. Although organic agriculture is practiced in Sri Lanka to a certain extent, it is important to look at what factors influence their decision to engage in organic farming and the awareness and attitudes towards the organic Farming, in order to assess what are the factors make them to take decisions about their engagement to organic farming. The research was conducted in the Tangalle D.S division. Sampling frame was the entire vegetable farmers in Tangalle D.S division. A group of 117 vegetable farmers were selected from 72 GN divisions using the simple random sampling technique. The research approach was deductive and type of the research is descripto-explanatory. Primary data were collected through interviewer administrated questionnaire and descriptive statistics and binary logistic regression were used as data analyzing techniques

Majority of the sample are male (78%) and most of them are in the age range between 41 years to 50 years. Most of farmers educated up to primary education level. According to the logistic regression results there is a significant influence for the preference to engage in organic farming from several socio economic factors. Those are income, education, gender and cultivated area. According to results among several cultivation practices there is a high awareness for using natural fertilizers, mulching and natural pesticides. When considering the risk, most of the farmers (61.5%) believe that there is a high risk in engaging with organic farming and most of farmers who believe high risk is in the age range of 36 to 50 years and most of the farmers who thinks that there is no risk in engaging with organic farming are belong to more than 50 years age range. When considering about awareness most of the farmers (47%) aware about existing market for organic vegetables. When considering the farmers, priority for several potential and constrain factors they gives more priority for health benefits and least priority for sustainable yield as potential factors and they give the more priority for short supply of input and least priority for low knowledge.

FACTORS AFFECTING FOR THE DIMINUTION OF SMALLHOLDERS PARTICIPATION IN RUBBER CULTIVATION

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Sri Lanka is one of the nine major producers of Natural Rubber (NR) in the world. However, over the years, there has been a sharp decline in the area under small growers which has led to a decrease in the total production of rubber. Most of the farmers have changed from rubber cultivation or to other crop cultivation. This can severely affect the Sri Lankan economy. It is important to study about the various reasons for the reluctance to engage in rubber cultivation and other affecting socio- economic factors to see whether there is an association for the decision to change. This study was carried out in Seethawaka DS division in Colombo district, the fourth top rubber growing district in Sri Lanka. The sample consists of 120 smallholders who are still engaged and shifted from rubber cultivation. Data collection was done through face to face interviews using structured questionnaires. Descriptive analysis and non-parametric test such as Chi-squared test, factor analysis were used for analysis.

When considering the key socio-economic factors majority of rubber small holders are males who are between 45 and 65 years. Majority (28%) have total income between Rs. 30,000 and 40,000. Rubber cultivation is an additional income of 81% of the farmers. The major income of them is private sector employment and self-employment. About 55% of farmers have land extent between 1 to 2 acres who secure the highest percentage and 67% of lands are single owned. About 82% of farmers have previous experience on rubber cultivation. Monthly harvest per acre is between 45kg and 90kg. Monthly income of 62% of the rubber cultivators is less than 10000 rupees. Majority of cultivations have "PB 86" clone. Most of mature cultivations are "PB 86" and newly grown cultivations are "RRIC 121". Tapping is done most of the times by farmers. Among the farmers 18% have totally dropped rubber cultivation and 14% are partially planning to go to other cultivations. So the total is 32%. The most critical problems that farmers have to face are; no fixed price for the produce, rain interferences, lack of skilled tappers, diseases in rubber and low yield per acre. There is an association between the decision to drop rubber cultivation and age, level of education, number of family members, experience, level of total income, level of income from rubber, land extent, harvest per acre, stage of cultivation, land ownership, operation (farmer himself or care takers), major income or additional income. Most of the farmers prefer to grow tea followed by coconut instead of rubber. It is important to overcome these problems and take up the challenges to retain the farmers in rubber cultivation and to secure the place as a major natural rubber exporter to the world. So it can be suggested that to improve productivity through awareness raising, introduce rain guards, develop disease resistant clones, shorter gestation period, better adaptability to climatic stress clones and awareness raising, incentive and skill development-tapping, improve market conditions-proper price, policies to control transition of rubber lands to other crops/uses, establish new or proper functioning of existing rubber small holder organizations or societies.

**IDENTIFICATION OF THE IMPORTANCE OF SURFACE
TREATMENTS FOR THE FUNCTIONAL VALUE:
USE OF TEXTURAL SURFACE IN EARTHENWARE PRODUCTS**

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Clay is a natural material that can be found from the earth; clay, water, air and fire are the main components of pottery products. Sri Lankan pottery industry is trace back to pre-historical era. The stage of surface treatment gets a significant place in the clay ware manufacturing processes. It adds an additional value to the art piece. Therefore identification of surface treatment methods is an important area of the earthenware industry. Different types of decoration techniques can be identified in the traditional earthenware processes. Among them, texture is an important design element in the clay object. Textural surface added aesthetical appearance and also the structural validity to the surface. Most of earthenware products did not pay much more attention about surface; therefore, this research tries to identify importance of textural surfaces specially physically and structurally. Not only that but also the surface treatments are directly and non-directly affect the product functionality.

This research considers about the texture and importance of the textural surfaces for the product usage and research limited to study only about the earthenware culinary products. This research is based on the grounded theory method and the required data were collected through an extensive literature review and different types of textural surfaces in variety of earthenware items are main samples in this research. The result of the data analysis leads that the textural surfaces are directly and non-directly affected to the functionality and usage of the product.

The main findings of this research are identifying various textural methods and its importance for the object and usage. It will be helpful to identify main key considerations for the new designs and reconstruct earthenware products very effectively in Sri Lanka.

Not Presented

ZOO-ARCHAEOLOGICAL REMAINS FROM THE WELI-MALUWA EXCAVATION OF THE JETAVANA STUPA IN 2003

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The Weli-Maluwa excavation of Jetavana Sthupa in 2003 has been carried out by the Jetavana Central Cultural Fund Project. The site has revealed twenty three (23) contexts, four phases that consist of many artifacts including faunal remains. The main objective of the present research to find out past culture, through animal bones prior to the construction of Jetavana Sthupa, which would support to reconstruct the subsistence pattern, socio-economic situation and past environment.

The identification of faunal remains was carried out on the basis of the recent zoo-archaeological methods such as Number of Identified Specimens, Weight methods, Calculation of unidentified bones, determination of age and sex, osteometric analysis and reference collection of the present day animal skeletons.

The site comprises a total of 139 bone fragments, of which 6 % (N=87) of bones are identifiable. On account of weight of bones, the identifiable bones are 83%. The unidentifiable bones occur due to the human and non-human activities. The total of 34% (N=29) bones belonged to cattle species (*Bos indicus*). Concerning the bone fragments of wild species, the wild pig (*Sus scrofa cristatus*) was the dominant animal (27%); followed by spotted deer (22%) and hare (5%). A total of frequency of bird bones is 2% in the faunal assemblage while reptile species contained 3% bone fragments.

The occurrence of cattle bones provides evidence for manifold activities. It is possible to identify butchering and cut marks on the bones of spotted deer. Phase 1 has not yielded any animal remains. However, other Phases reveal some evidence for human occupation at the site. A few bones of hare, wild pig and barking deer consist of high meat bearing parts that indicate the consumption meat of those animals. The ratio of the wild and domestic bones is useful to consider a relative chronology for the period between 300-700 BC.

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PHILOSOPHICAL ASPECT OF SHORT POEM

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Today, poets and readers are excited about brief verses. It has proved that tabloids of daily newspapers are very much popular among the readers due to their simple language. At present human beings are so busy with their schedules. They don't have enough time to engage with literary activities or read novels, poems and so on. Short poem is one of interested methods to read a kind of writing. Short poems are included not as much of words and they do not waste additional words as well. If there are not many words it does not mean that it has no multiple meaning. A Short poem has a massive meaning with few words. Therefore, nowadays people are very excited to read and write short poem. Someone tries to define that short poem as useless and meaningless. It might be a completely wrong idea. Short Poems carry philosophical aspects. It is not easy to realize that what philosophical aspects are. One who is of sharp, concentrative and open minded, he can understand the real meaning of the short poem. As well, poets of short poems don't use figurative style and they do not use exaggerative similes and attractive metaphors. But they use an emotive language, a direct phrase, meaningful usages, rhetoric and an imaginative language to describe the reality of the world. Those reasons are mainly joined with the main research point called philosophical aspect of short poem. In that sense, this research tries to find philosophical meanings of short poem.

Furthermore, short poems do not carry many words. But they carry a greater meaning from a minor word. Japanese Haiku poems are one of admirable examples. According to the Sri Lankan short poem, there can be seen very significant poems which are appropriated with this research. At present *Ariyawansa Ranaweera* is one of most prominent Sri Lankan poets who has a prominent capability of this field. His poems will keep as the sources to the research problems. The ultimate goal of this research was to examine how short poem includes philosophical aspects. According to research, Buddhist concept, nature of the life, reality of the world and more philosophical aspects are elaborated from short poems while using emotive language, a direct phrase, meaningful usages, rhetoric and an imagination language. These important facts can be seen in Short poems from few words. That is the most amazed fact of short poems.

VISION TO COGNITION: AN INVESTIGATIVE STUDY ON MOTTOS USED BY THE SINHALA PRIVATE CLASSES' TEACHERS BASED ON GAMPOLA, NAWALAPITIYA AND KANDY AREAS

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Usage of a motto or a theme almost for every task is a modern trend of Sri Lankan society. The term 'motto' derived from the Latin word *muttum* and has the meaning 'a short sentence or phrase chosen as encapsulating the beliefs or ideals of an individual or institution.' Motto represents in the meaning of theme too at present such as, theme song of a teledrama or a film, theme of a novel or a poem, theme color of something, wedding theme. Using of a motto has become a very common phenomenon in current private tuition sector too. Private classes are a kind of modern education system that has a commercial purpose as well. System of Private tuitions has its own features and methods, based on the popular culture with the purpose of student attraction. The standard of features and methods are changed the way that teachers think.

Almost all the private teachers engage in putting a Motto on their tutorials, cut outs and posters at present. The main research problem of this paper is to find that which kinds of reasons have led to use a theme for their classes. The objective is to reveal whether their purposes achieved or not through the use of mottos. The mottos used by the teachers who conduct Sinhala private classes in Nawalapitiya, Gampola and Kandy are selected for this paper as primary sources and the facts that collected by making personal interviews with teachers are also to be analyzed.

According to the research, there are many reasons in using a meaningful motto or theme, such as drawing attention and attraction, stressing the quality of the class and the teacher, following the popular trend, motivation of the students, making attitudinal changes, achieving popularity and neglecting the standard of other classes. As all these reasons are bound with vision of the students they have decorated the motto with marvelous and classical Sinhala words, radical words which are popular in contemporary society and in poetical pieces. Most of the students get an idea about the class and conclude the standard of it looking at particular mottos. When the mottos get popular within the students, it is caused to adequately reflect about the class in student mind. As the conclusion, it must be stated that the tuition instructors use a motto as a way of achieving popularity, getting the attraction of students and including many reason mentioned above with commercial aspect too.

Not Presented

THE ETHICAL FOUNDATION OF THE CONDUCT OF ENLITENED PERSONS (*ARAHANTS*)

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Ethical degeneration is root cause of many crises of contemporary society. This has paved the way for a corruption at numerous levels. As a result many non-ethical practices appear harming peace and harmony in society. A religious and ethical approach is very important to bring about a change in this situation. Buddhism advocates the enlightened person (*arahant*) as the most ethical person and the ideal character that should be followed by ordinary persons. This paper discusses the ethical foundation of the conduct of an enlightened person with reference to early Buddhist teachings. The main objective of this paper is to show the practice of *Arahants* for the purpose of reducing one's non-ethical behavior. The ideal man at the highest stage of development is called an '*arahant*'. The word '*arahant*' is derived from the two words '*Ari*' which means 'enemy' and '*han*' which means 'to kill', so that *arahant* would be 'A slayer of the foe', the foe being the passions. All morally and ethical evil is reducible to the three character traits, greed (*lobha*), malice (*dosa*) and delusion (*moha*). These three are considered as primary dispositions which result in diverse kinds of moral evil. The numerous patterns of bodily, verbal and mental behavior characterized in Buddhism as *akusala* are said to be the natural expression of these dispositions. Due to those dispositions, ordinary people always behave in misunderstanding the real nature of the world. As a result of this misunderstanding, they tend to do ethically and morally evil things which are harmful to themselves and others. Considering the persons who are called *arahants* they are persons who by definition have eradicated all evil dispositions. Therefore, they do not dispute with each other over the worldly things unlike ordinary people. And they do not engage in wrong doings which are harmful to themselves and others. The ethical qualities of the *arahants* as described in the Suttas can be summarized under some major aspects of character developed by them: Virtue, wisdom, and meditative and other spiritual faculties. Mind is "developed", "steadfast", "well-released" and without ill-will when confronted with objects of the six senses, he or she has equanimity and is not confused, seeing only what is seen, and hearing only what is heard, without mental projections and yearnings such as attachment, desire, and aversion. The six senses are "controlled" and "guarded". He or she is "self-controlled" (*atta-danto*) and "with a well-controlled self" (*attanāsudantena*). Finally, we can say that the enlightened person is the ideal persons to follow for the total elimination of ethically wrong behaviors.

Not Presented

SPATIO-TEMPORAL VARIABILITY OF FERTILITY AND MARRIAGE BEHAVIOR IN SRI LANKA: DEMOGRAPHIC EXPLANATION FOR FERTILITY TRANSITION

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The analysis of spatio-temporal variability of fertility and marriage behavior is one way of explaining fertility transition in a country. This study compares and contrasts the fertility, fertility behavior and marriage behavior both spatially and temporally. None of the fertility studies in Sri Lanka have attempted to explain spatio-temporal variability of fertility, fertility behavior and marriage behavior using first and second demographic transition theories.

An overview of contradictions of demographic characteristics related to first and second demographic transition has been developed by Lesthaeghe (2010) and that framework is used to compare and contrast the spatio-temporal variability of fertility and marriage behavior. Multi-stage stratified random sampling procedure was used to select the respondents. The sample size was 743 and data was collected by using a survey questionnaire. One-way ANOVA and proportion comparisons at $\alpha = .05$ were done to compare spatial and temporal differences of variables related to fertility and marriage behavior. The correlation analysis is used to analyze the relationships between fertility and marriage behavior.

According to research hypothesis it was assumed that the fertility transition has occurred from rural space to urban space. However such transition can be observed but fertility has not reached below replacement level even in the urban space. The temporal analysis showed that all measures of fertility were low in the first and second generations and the first generation has reached the replacement level of fertility, and further the first generation in urban and rural spaces have reached the below replacement level of fertility. Based on these findings it can be concluded that the spatial variability of fertility will be diminished in the future, because fertility of the first generation is similar in the three spaces.

Although the research hypothesized that the institutional changes of marriage: increase of childlessness, increase of unmarried, increase of ever born children, increase of marriage dissolution and decrease of remarriage are the main factors for fertility transition through space and time, it was revealed that those factors do not significantly contribute to fertility decline over space and time.

However, it is hard to expect that Sri Lanka will remain at below replacement level of fertility and she will reach to second demographic transition in future, because demographic factors, which are favorable to fertility transition, are reversing in the first generation in all three spaces.

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SENSUAL PLEASURE: AN ELUCIDATION OF VARIOUS PERSPECTIVES IN BUDDHISM AND OTHER MAJOR RELIGIONS

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Sensuality is a natural phenomenon which is common for all living beings in the world. It can have biological, emotional/physical or spiritual aspects. It is not subject to doubt that among the living creatures, human beings are highly affected by Sensual Pleasure because of the complexity of their way of thinking. In common, Sensuality is a widespread and mostly discussed fact in most religions and philosophies in the world. According to the perspective of Buddhism, sensuality is what bonds the person *Samsāra*, the cycle of existence and distances one from *Nirvāna*, the liberation. In the process of sense experience that the individual goes through interacting with objects that come through the sense faculties, 'sensuality' becomes a fundamental reaction in the mind of person. Sensuality also what stimulates the person to worldly activities and it can be described as the root of individual behavior.

Generally, 'Sensuality' or 'Sensual Pleasure' plays a key role in the behaviour of human beings. Therefore, the theme of sensuality is variously described and interpreted in many philosophies and religions, in connection with mundane life as well as the ultimate goal that humans aim at. So, for a clear understanding of sensual pleasure as interpreted in Buddhism, it is important to gain an adequate knowledge about the religious and philosophical notions and definitions regarding sensuality presented in the various religions and philosophical systems. Therefore, the purpose of this paper is to briefly examine the manifold interpretations of sensuality in major religions and philosophies.

When we draw our attention to the prevailing world crises, it is apparent that many disturbing conflicts are increasing day by day because of the growth of human Sensuality and craving for the enjoyment of sensual pleasures.

Thus, in this paper, an attempt is made to point out the Buddhist view on Sensual Pleasure, comparing other religious perspectives, paying attention to the way in which an understanding of this nature could have an impact on the healing of worldly ills and an improvement in the achievement of supra-mundane human goals.

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A STUDY OF RITUAL AND BELIEF IN RICE CULTIVATION IN A CONTEMPORARY KANDYAN VILLAGE

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Rice cultivation has long served as a locus of religious belief and practice in Sinhalese culture, illustrating the integrative and multifaceted nature of traditional Sinhalese religious experience. This research examines contemporary rituals and beliefs associated with rice cultivation in the upcountry Sinhalese village of Ekiriya, located in the vicinity of Rikillagaskada, a region that encompassed the last vestiges of the 19th century Kandyan kingdom. The study first aims to descriptively illuminate the complex ways in which religious culture is embedded in agricultural sustenance, and then seeks to understand how these beliefs and practices compare to ideal types derived from traditional Sinhalese village contexts of the past. The researcher uses extensive participant observation and interviews with village people in Ekiriya to illustrate a localized contemporary reality, and analyzes textual as well as oral sources to provide historical context and frame traditional paradigms of ritual and belief for the purpose of comparison.

The study captures a rich mosaic of beliefs and practices associated with contemporary rice cultivation in Ekiriya. This includes the removal of shoes and worship of tools within the paddy fields, the use of altered vocabulary within the threshing field (*kamatha*), the veneration of trees such as the *kumbuk* for perceived water-cleansing properties, and the rituals of *aluth sahal mangalle* and *adukku* that situate the agricultural cycle within a popular cosmology of the Buddha and protectorate deities. The pluralistic nature of these beliefs and practices suggest that a unique confluence of Theravada Buddhist tradition, Hindu influence, and localized religious consciousness is embedded in the contemporary culture of rice cultivation in Ekiriya. Moreover, the persistence of traditional paradigms alongside localized customs suggests that this array of beliefs and practices has been transmitted into its present instantiation through a process of continuity pertaining to ideal types as well as departure, actively negotiated as Ekiriya has encountered the influential paradigms of Kandyan kingship, British colonial pressures, commercial tea cultivation, tobacco farming in response to western demands, and recent economic and sociological conditions. The study concludes by contending that the paddy fields themselves are continually understood as a sacred place imbued with spiritual value, suggesting that religiosity and agricultural sustenance retain their traditionally inextricable relationship, though the religious culture of rice cultivation is rapidly changing in response to contemporary social, political, economic, and environmental realities.

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INFLUENCE OF BHATIYALI FOLK SONGS OF WEST BENGAL ON NORTH INDIAN CLASSICAL MUSIC (RAGA SYSTEM)

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The present study examines how North Indian Classical music (Raga System) has been influenced by the melodies of *Bhatiyali* folk-songs. The materials used to examine this concept include treatises, comparing the scales of both systems and their melodies, characteristic phrases and notes (svara), seminars as well as field survey conducted by the candidate. The literature survey included Sanskrit treatises and scholarly studies. Field study was performed to seek melodic evidence to identify and analyze the influence of *Bhatiyali* folk songs on North Indian Classical Music (Raga system).

According to Pundit Rabindranath Tagore, folk songs may not have ostentations of classical music. His ideas demand that folk music system should be a separate study distinct from classical music. But this subject has been reverted later in detail. The primitive music and folk music of India are comprehended in principles of Indian classical music. Evidently, the Indian Classical Music (Ragas System) has been influenced by folk music through the ages. Some folk music of West Bengal as such *Bhatiyali* has gone into the methods of basic Indian Ragas and Taala system. *Bhatiyali* is the root of folk songs of West Bengal. The melody of *Bhatiyali* resembles the main notes of Raga Bilawal, Bihag, Pahadi, Jhinjhoti and Khamaj etc. when compared the two systems and their scales of melodies as well as the treatises and seminars.

THE CHALLENGES OF THE MICRO-ENTERPRISES IN SRI LANKA: A CASE STUDY OF HAMBANTOTA

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Since 1977, the focal point of development discourse of Sri Lanka is on bottom-up approach with the partnership of public, private and civil society. The bottom –up development aspect encourages the public participation, grassroots empowerment and equal distribution of development benefits. One of the highlighted methods of bottom – up development approach is that enhance local level micro-enterprises. The government of Sri Lanka (GOSL) has recognized micro-enterprises as a way of connecting rural community to development. Therefore, GOSL has paid attention on expanding the opportunities for micro-enterprises with decentralizing the power and tasks of micro-enterprises among private sector and civil society. Private sector and civil society in Sri Lanka therefore have being working with the micro-enterprises at local level. Though the tasks and power of micro-enterprises has been decentralized, GOSL is still dominating the policy making for micro-enterprises.

However, the government policies of micro-enterprises in Sri Lanka have been challenged by the economic and political decisions made at national level. The national level infrastructure development policies, tax and import-export policies have challenged the local – micro enterprises/micro-entrepreneurs. The socially constructed phenomenon such as gender and religion are also affecting in the development of local micro-enterprises.

The research problem in this study is that why have the local micro-entrepreneurs of Sri Lanka subjected to the marginalization, isolation and uneven distribution of development policies at national level. Two research questions has linked to the research problem; how rural micro-entrepreneurs have been challenged by the development decisions taken at national level? What challenges and constraints pertaining to the female micro-entrepreneurs of rural Sri Lanka by social, economic and political situations? The qualitative data were collected from 30 individual micro-entrepreneurs and 6 supportive institutions for micro-entrepreneurs in Hambantota municipality. Semi-structured interviews were done with 15 female and 15 male micro-entrepreneurs and 6 supportive institutions for micro-entrepreneurs. Grounded theory and inductive methodology has been used in data analysis.

The institutional failure of linking national government and local micro-entrepreneurs is key challenge of micro-enterprises in Sri Lanka. Local micro-entrepreneurs have the challenges of participation, communication and forming the collective bargaining and representing them at national level decision making for development. Gender sensitivity and women subordinated public and private sphere, the absence of corporatism, red tape bureaucracy, illiteracy, economic vulnerability and financial uncertainty are the challenges pertaining to local micro-entrepreneurs in general and female micro-entrepreneurs in particular. The government, private sector and civil society as development agents should modify the micro-enterprise agendas in order of the geographical and functional capacities of the area. Patriarchal values in market should be replaced by women-friendly vales and need to establish the supportive system for female-headed micro-entrepreneurs. Integrating local development needs and national development plans and adjusting the development plans to strength opportunities for micro-entrepreneurs are important policies to enhance the local micro-enterprises of Sri Lanka.

ALTERNATIVE COMPENSATION MECHANISMS AND THE FUTURE OF AQUILIAN ACTION: SUGGESTIONS FOR A COMPATIBLE FUSION

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Basically, the function of the Aquilian action is to compensate pecuniary loss resulted by negligently caused physical injury to one's body or property. The liability imposed hereunder is called 'fault-based liability' since the imposition of the liability is based on 'fault' which has to be proven by the plaintiff on the part of the defendant. However, the Aquilian action is constantly subjected to criticism owing to its reluctance to effectively provide adequate compensation for dynamic claims. To address such claims shaped by socio-economic changes took place during past few decades; a regime of alternative compensation mechanisms has emerged simultaneous to the Aquilian action under Law of Delict. These are identified in three broader categories such as insurance, social welfare and interrelationship and possess the capability of performing the primary function of the Aquilian action, which is namely 'restitution'.

Claiming compensation through these mechanisms has become a trend at present due to its non-litigation process which ensures the victims a due amount of compensation without extra burden of proving 'fault' unlike in the Aquilian action which is more time consuming, expensive and barely endurable to the general populace. Hence, it has become a timely requirement to probe into these alternative mechanisms and their impact on the Aquilian action since the heightened public attraction to these alternative mechanisms has already posed a threat on the usage and existence of the Aquilian action.

This paper mainly collates knowledge regarding alternative mechanisms available in Sri Lanka to claim compensation for negligently caused injuries. It also discloses the causes which induced the emergence of such mechanisms alternative to the traditional Aquilian action. It spreads light on the impacts of such mechanisms on the future of the Aquilian action. Illustrations are imported from foreign jurisdictions such as United Kingdom, Australia, Singapore and New Zealand to analyse how alternative compensation schemes could be more sophisticatedly and competitively applied without abandoning the Aquilian action. The paper brings both general and specific recommendations for a fusion of prevalent schemes to prevent the Aquilian action from complete disuse while leaving sufficient space for the competitive application of alternative mechanisms. This paper carries a qualitative research based on library and internet search. The substantive support is mainly taken from legislative enactments, case reports, scholarly texts/articles, newspaper articles, public and official documents and reports. Materials which encapsulate data with reference to the development of such alternatives in foreign jurisdictions will be located from web search and related scholarly texts. In one hand, the increasing public attraction to novel compensation schemes is irresistible and on the other, it is absolutely disadvantageous, in the long run, to totally do away with Aquilian action under the Law of Delict since its role in policy making, social reforms, setting standards of conduct and generating new principles of law is hardly played by said alternative. Therefore, a compatible fusion of Aquilian action and alternative compensation mechanisms which consists of preliminary judicial examination process based on a special strategy for the allotment of cases, a monitoring mechanism and a special advisory committee for alternatives, is suggested in this paper to encourage fair competition between both mechanisms and enhance access to justice under the purview of Law of Delict.

EFFECTIVENESS OF INFORMATION LITERACY PROGRAM CONDUCTED BY THE MAIN LIBRARY OF THE UNIVERSITY OF PERADENIYA FOR POSTGRADUATE STUDENTS IN EDUCATION

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One-day opportunity was given to the library to conduct an Information Literacy (IL) programme for the students of the Postgraduate Diploma in Education (PGDE) of the Faculty of Arts. The objective of the study was to compare the post and pre-test scores of programme participants and to recommend the future directions of the IL programmes. Out of 136 students, 82 attended and they were given a pre-test to check their knowledge on selected information skills. After the pre-test the entire group was given active lectures on Online Public Access Catalogue (OPAC), books and periodicals, searching of scholarly e-resources; Open Access resources, internet and Google scholar during the morning session. After lunch they were divided into 06 groups and each was assigned an experienced staff member to do a demonstration on a topic covered in the lectures. Students were given the opportunity to practice although the time was limited. At the end of practical sessions, participants took the post-test and the scores were analysed using descriptive statistics. Scores of the pre-test indicated that 97.6% were not aware of library software, 69.5% did not know about the OPAC, 97.6% did not know about the databases available in the library, 100% did not know how to build search terms, 91.5% did not know what an act of plagiarism is, 100% were not aware how to evaluate internet resources and 100% did not know about the three retrieve terms. There was a significant increase in their knowledge after the pre sessions. 77.8% could identify library software, 77.8% knew how to search the OPAC, 69.1% could list three databases available in the library, 50.6% knew how to build search terms, 66.7% could identify acts of plagiarism, and 53.1% could name criteria to evaluate Internet resources. 88.9% were known about the three retrieve terms after the session. This study revealed that the student awareness of the information resources and how they could be used effectively in their studies is minimal or absent in certain areas. The awareness could be increased considerable with a one day IL programme. It is recommended that the department provide guided learning opportunities for the students, in the library to develop the actual skills.

CHANGING ETHNIC MOSAIC OF COLONIAL PORT CITIES IN ASIA: THE CASE OF COLOMBO

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Colonial port cities in Asia were established between the sixteenth and early nineteenth centuries as European-controlled fortified port towns. They became extensive cosmopolitan urban centres of multi-ethnic trading communities engaged in long-distance maritime trading and shipping activities. These cities can easily be distinguished from others as centres of constant movement of peoples and commodities, financial and administrative functions as well as of socio-cultural interaction. These cities also served as regional imperial capitals of various European empires tying up diverse regions into a network of global modes of production, exchange and consumption. At the same time they exercised economic and political control over their respective hinterlands and integrated them into broader structures of the colonial economy.

Colombo underwent many changes under successive colonial powers, the Portuguese, Dutch and British and evolved over time to accommodate characteristic imprints of these rulers and their respective colonial ventures. This research will focus on development of the port city of Colombo from the beginning of the Dutch rule in 1658 until the end of British colonial rule in 1948, when the Sri Lankan economy transformed into a typical colonial plantation economy. With this the old Sri Lankan trade pattern undergoes a radical change and becomes a centre of colonial production. This generates demands for new forms of trade, labour, skills, and services that the indigenous population was unable or unwilling to meet and leads to entry of migrant communities and the growth of ethnic cosmopolitanism. Accordingly the character of Colombo as a port city undergoes a rapid transformation. While Colombo attracted various groups of people from many parts of the world it was the Indian trading communities who made the most lasting contribution to the ethnic mosaic. Their imprint persists even today in the demographic composition of the city and in its religio-cultural character.

The aim of this study is to examine the changing ethnic character of Colombo as a case study of Asian port cities under colonialism. Principle problem addressed in this research is the immigration pattern of various ethnic groups and their impact on the colonial port city of Colombo.

Both qualitative and quantitative approaches of data collection and analysis will be used in this research. The main body of information and data will be based primary on archival sources and statistical records of colonial governments in Sri Lanka and the Netherlands. In regard to the qualitative approach, interviews will be conducted with the descendants of each community still living in Colombo or suburb to gather information of their family histories. The research will also involve a search for private collections of documents of their families. The visual aspects of the development of the port city will be undertaken with the help of architectural remains of Colombo and maps and plans of the city.

SELF-RELIANCE STRATEGY IN SRI LANKAN RURAL DEVELOPMENT: A STUDY WITH SPECIAL REFERENCE TO SEEDS (GUARANTEE) LTD OF THE SARVODAYA SHRAMADANA MOVEMENT

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The need for establishing self-reliant rural economies is highly felt in the contemporary developing nations with the drawbacks in national development created by dependency syndrome in the past. In Sri Lanka, the Sarvodaya Shramadana Movement is the first to adopt such self-reliance strategies to gear the rural development in the country. In this study, the basic self-reliance principles of the Sarvodaya Shramadana Movement are assessed. For this purpose, Sarvodaya Economic Enterprise Development Services (SEEDS), which is the economic hand of Sarvodaya, and its rural development activities are analyzed.

The study collected data on the role and activities of SEEDS (Guarantee) Ltd in establishing a self-reliant village economy. Primary data were collected through in-depth interviews with the personnel of Halwatta Divisional Branch Office of SEEDS (Guarantee) Ltd, Kandy District. Secondary data were collected from various books and articles on Sarvodaya Shramadana Movement and SEEDS (Guarantee) Ltd.

The study found that SEEDS (Guarantee) Ltd promotes self-reliance in rural Sri Lanka through a wide range of financial and non-financial services. These include encouraging savings habits, improving the money management capability, increasing the income generated by existing businesses, initiating new businesses, generating income for the society to cover costs of social development within villages, developing communication and personal negotiation skills of community members for higher social inclusion, providing career guidance for women, providing legal and financial literacy and providing health and hygiene of all. It also employs a number of basic self-reliance strategies such as encouraging mass participation, promoting self-employment, developing entrepreneurship, utilizing local resources, promoting self-sufficiency and lessening alienation of villages. The organization also strives to generate funds through its own income generating activities. However, still there are some factors such as flow of funds from external sources, poor mass participation, financial misconducts of Economic Empowerment Groups (EEG) that are not compatible with its self-reliant aims and approaches. The study concludes that SEEDS (Guarantee) Ltd of Sarvodaya is gradually demonstrating its capability in the promotion of self-reliance in the Sri Lankan village economy as it tries to build up a new indigenous form of socio-economic independence in village Sri Lanka.

**THE CONCEPT OF SELF IN BUDDHISM AND JACKQUES LACAN'S
PSYCHO ANALYTICAL PHILOSOPHY:
A PHILOSOPHICAL ANALYSIS**

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Buddhism founded by Gautama Buddha, 6th century B.C discusses the concept of the self in subtle way .Generally it is known as *anatta* (no soul) or stream of consciousness. *Anathmavada* is one of the important arguments of the Buddhism against the traditional Hindu Philosophy which strongly advocates existence of the permanent and immortal soul apart from changing world with capable of taking rebirth and attaining liberation. The Buddha conceives like Heraclitus, one of the ancient Greek philosophers who believe in universal flux. The change is insisted in three dimensions in Buddhism Known as: everything is sorrow (*sarvam dukkam*), everything is momentary (*sarvam ksanikam* and everything is devoid of self (*sarvam anatma*). However, the three aspects can be reduced into one and only aspect / concept 'change'. Buddhism interprets the man is the bundle of five *skandhas*: matter (*rupa*), feeling (*vedana*), perception (*samjna*), disposition (*samskara*) and consciousness (*vijnana*). The first *skantha* is called body (*rupa*), it is material in nature and the other four *skanthas* considered as '*nama*'. A human being is a joint product of *nama* and *rupa*. The combination of the four *skanthas* can be called as the self or the mind or stream of consciousness, 'I' consciousness and 'My' consciousness, etc. As per Buddhism 'the self' is unreal because of its momentary and false existence. Jacques Lacan (1901-1981), a French psychologist and psychiatrist analyses the self. Lacan's interpretation of the self is conceived as a mix product of the thoughts of Kant, Hegel, Nietzsche and Freud. In this back ground, it cannot be completely neglected the influence of Buddhism on Lacanian thoughts of the self and It is unbelievable that many characteristics attributed to the self by Lacan have more similarities with the self of Buddhism This paper analyses similarities and dissimilarities between the two 'philosophies through the works of the Buddhism and Lacan. This paper also tries to analyze problems and solutions associated with the self that flourished different period of time and to enlighten humanity with a new outlook of the knowledge provided by thoughts of great masters of the east and the west.

**USAGE OF ELECTRONIC INFORMATION RESOURCES DURING
PREPARATION OF FINAL YEAR DISSERTATIONS BY UNDERGRADUATES
OF THE FACULTY OF ARTS, UNIVERSITY OF PERADENIYA:
A CASE STUDY**

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Libraries all over the world provide access to a wide variety of electronic information resources (EIR) to their clients. These EIR form an important part of the reference resources provided by the academic libraries. Readers are increasingly encouraged to use electronic resources for their research purposes. It is evident that not all undergraduates consider the library as an important place during their course of study, especially at the preparation of final year dissertation. Therefore the main objective of the study was to examine the usage of EIR by final year undergraduates during preparation of their final year dissertation.

Methodology used in this study was a survey research design with applying purposive sampling method. Total of 49 final year students of Arts special degree program who visited the Main Library were voluntarily participated to this survey during one month period of time from 01/03/2015 to 31/03/2015. Descriptive statistical method and Rank Based Quotient (RBQ) were used to analyze data.

The study findings indicated that the students used internet search engines rather than specialized databases and full-text resources to search information during preparation of their dissertations. Nearly 88% of the respondents had never used library web page to search EIR. Nearly 10% were familiar with electronic resources available in the library. Some of the students were not aware of the Online Public Access Catalogue (OPAC) and they were not competent to use EIR. The main problems associated with non-use of EIR are: lack of skills in information searching and very limited training opportunities. Limited facilities for accessing internet are also an issue for them. According to findings the reason for low usage of electronic resources by undergraduate is mainly due to lack of basic skills / knowledge in IT English language barrier. In order to exploit the full potential of electronic information, university library and the faculty staff should play more active roles by organizing awareness programmes, promoting students' use of EIR and educating them. It is essential to introduce information literacy skills courses for students and it should be included in their curriculum as a compulsory component. Academic staff should encourage students of First year through final year to use EIR. Establishing a well equipped IT lab is recommended for the main library.

PLANTATION TO URBAN: PHENOMENON AND CAUSES OF YOUTH MIGRATION IN THE PITAKANDA ESTATE, MATALE

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The plantation sector comprises of a large and vital sector of the economy in Sri Lanka. In the recent years, migration from plantation to urban becomes a significant phenomenon of the plantation areas in Sri Lanka. Various factors influence on the migration of youths from plantation to urban areas. The objective of this study is to explore the youth migrants' characteristics, their destinations and causes for the migration from plantation to urban areas. This study was conducted in the Pitakanda estate of the Matale district.

Quantitative technique is the primary method to achieve above objectives in this study. Questionnaire survey was conducted to gather quantitative data. All active internal migrant's households were considered as the population in this study. Among them, forty (40%) percent of the households were selected for the questionnaire survey. Respondents were identified through systematic sampling process. Qualitative techniques also utilized to supplement above quantitative data. Particularly, focus group discussions, observations and in-depth interviews were conducted to collect necessary data. Lee's (1966) "push - pull" factor model is used in this study to analysis the phenomenon of plantation to urban migration.

This study found that unemployment and insufficient income are two key factors push the youth from Pitakanda estate and 41% of youths migrated due to unemployment and remaining 32% of them migrated due to insufficient income from available jobs in the estate and surrounding areas. Primary destination of the majority of youths (62%) is Colombo. Boys prefer to migrate to longer distance while girls keen to find jobs in the shorter distances. Majority of the youths are economic migrants and finding a suitable employment with good remuneration is the primary objective of them. Closing down of the estate tea factory (*L-shaped factory*) is the main reason for their unemployment in the estate area. Lack of employment opportunities and low wages in Pitakanda estate stimulate the youths as significant push factors. On the other hand, employment opportunities and comparatively high salaries in Colombo attracted the youths as pull factors to this mobility. Push factors are strong enough than pull factors to motivate this migration phenomenon. Therefore, 'migration' is the only option for the majority of youths in Pitakanda estate for their livelihood. This type of migration provide remittances flows to the place of origin (Pitakanda) and labour supply of informal sectors in destination (Colombo). Therefore, proper approaches are necessary to manage internal migration from estate to urban to increase the benefits and decrease the burdens in both the origin and the destination.

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THE FORGOTTEN ONES: AN ASSESSMENT OF THE NEED FOR A COHESIVE LEGISLATIVE AND POLICY FRAMEWORK TO ADDRESS ALL STAGES OF CONFLICT INDUCED INTERNAL DISPLACEMENT IN SRI LANKA

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As of December 2014 nearly 90,000 conflict induced Internally Displaced Persons (IDPs) are reported from Sri Lanka despite the passage of five years since the end of the conflict. Even though statistics of IDPs have drastically dropped in the post 2009 time period due to de-registering IDPs as a result of various resettlement initiatives of the state, the returned IDPs continue to require assistance and protection while the fate of some of the IDPs remains unknown. It is a fact that inclusive statistics on IDPs are not easily accessible nor even exist for reference. There are no reports of the state having conducted a comprehensive profiling of conflict induced IDPs nor have they provided durable solutions for this population of concern. Therefore the said IDP population- both remaining and returnee- is in a precarious position in terms of protection and assistance needs. More profoundly, there exists a dearth in comprehensive domestic legislation or a policy framework addressing the needs of conflict induced IDPs in all stages of displacement. This study seeks firstly to assess the adequacy of the existing constitutional and legislative framework in providing protection for IDPs, and secondly, based on the initial consideration, discusses the adverse impact of the lack of a comprehensive legislative/policy framework to provide durable solutions to conflict induced IDPs. Lastly, the study seeks to propose coherent recommendations based on international best practices to bridge the gap in protection.

A review of available literature, including constitutional provisions, legislation and policy formulations, on the conflict induced IDP landscape in Sri Lanka was conducted in order to identify and analyse the extent to which protection needs of IDPs are addressed in the post-conflict era. The review focused on the initiatives of the state taken to ensure protection and assistance needs of the IDP population in all stages of displacement with a special emphasis on the post-conflict situation in order to assess the sustainability and viability of such measures, including resettlement processes, and to recognize any gaps inherent in the practices. Recommendations in line with international best practices are proposed to find durable solutions through the formulation of a national policy and legislative framework based on the analysis and findings of the literature review. Recommendations further include specificities of the proposed national policy and/or legislative framework. The analysis of literature highlighted the fact that protection and assistance measures lacks transparency and sustainability due to various reasons such as significant lack of available data, limited access of IDPs to information impacting their situation, land related issues and *ad hoc* non-durable solutions. Despite physical resettlement occurring, such communities lack access to basic living conditions, including adequate shelter, water and sanitation facilities. The situation is exacerbated by the lack of a national policy or legislative framework to address all stages of Internal Displacement.

It is concluded that the lack of a comprehensive legislative framework needs to be remedied in order for durable solutions to be formulated to address conflict induced displacement. It is recommended to adopt a domestic IDP policy in line with international standards through an inclusive, transparent and consultative process with all relevant stakeholders and features of the proposed policy and legislative framework are provided.

MURAL TRADITIONS IN TEMPLE ON PILLARS (*TĀMPITA VIHĀRAS*) OF SRI LANKA

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Structures built on a wooden platform resting on short granite pillars or stumps are a unique type of image houses from the 17th to 19th centuries called *Tāmpita Vihāras*.

This type of single roomed very small image house emerges in the early Kandyan Era. It has a wooden superstructure. The murals in the inner room or sanctum have a very rigid spatial arrangement. One can view the central seated image of the Buddha under a “*Makara Arch*” attended by fly whisk bearers and deities on entering through the doorway. The side wooden walls and ceiling have almost similar picture programs.

The *Tāmpita Vihāraya* has only one small ritual space. The *Vihārageya* or *Pilimageya* is the space where the devotee could visualize the living Buddha, venerate him by reciting Pali *Gāthās*. The innermost chamber or sanctum is the central place of worship. A seated Buddha is usually the main object of worship. The walls of the sanctum are adorned with Buddha statues, paintings of Buddhist monks (*Arhats*) standing in adoration. Protective Gods and other deities and future Buddhas (*Bodhisattvas*) face the main figure. Some mentors and donors also appear in the crowded space of the sanctum. The ambulatory narrates the life of the Buddha (*Buddhacarita*) and former births (*Jātakas*), how the future Buddha perfected his virtues with great selflessness (*Pāramita*) and Hells, which seems have been added later.

A speciality of the *Tāmpita Vihāras*, seen in the Kurunegala, Gampaha, Kandy and Matale Districts, is the statues, murals and decorative motives from the pre-Kandyan and Kandyan period of art. Under the guidance of the research team of the HETC Project at the Faculty of Humanities, University of Kelaniya a survey was conducted in 50 *Tāmpita Vihāras*, which revealed interesting patterns of Visual Communication.

Even in a bad state of preservation, murals of a *Tāmpita Vihāraya* show a layer of murals that reflect the Visual Communication of early 19th century. Very little research has documented the allocation of limited space for narratives and icons in *Tāmpita Vihāraya* and establishes iconographic patterns common to all *Tāmpita Vihārayas*.

A study that encompasses the *Tāmpita Vihāras* covering both Up Country and Southern Region has not yet been conducted. The Southern Phase of this project will throw new light on the Southern Tradition of *Tāmpita Vihāras*. The objective of the current research is to view the isolated *Tāmpita Vihāras* in the South in order to ascertain if the murals follow the tradition inherited from Kandy (*Udarata Sampradaya*) or Low Country tradition (*Pahatarata Sampradaya*).

REJECTING THE “KANDYAN TRADITION” IN THE SOUTH

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The objective of this article is to draw the historian’s attention to the 19th century Buddhist Activities in the Southern and Western Maritime Region. The focus is on the architecture.

If we trace the religious activity of the early 19th century moving to the Southern and Western costal belt, the allegation that the British were responsible for the total destruction of Buddhist practices of the entire island cannot be regarded as a historical fact: Many temples in the South (*Pahata Rata*) received patronage from the upcoming Sinhala elite, who had established themselves as patrons of Buddhism by building large temples. They were adorned with impressive entrances called *Torana* arches as seen in the temples on the coastal belt from Panadura, Vaskaduwa, Kalutara, Alutgama, Ambalangoda, Kumārakanda and Ranvella. Murals of high quality dated to the mid-19th century as seen in Telvatta, Mulgirigala, Mirissa, Kathaluwa, Kumārakanda, stand testimony that the temples could afford masters in mural painting.

The emergence of Queen Victoria as the patroness in the temple, with her portrait painted under the *Makara* Arch over the entrance, as well as the donations given to the temples provide some data that the essentialist statement of the British destruction of Buddhist temples has little historical evidence. In the Kandy Region (*Uda Rata*), on the other hand, especially during the Kandyan Rebellion, when in the middle of the 19th century members of the *Uda Rata* and *Sabaragamu Radala* (nobility) attempted to oust the British Regime, many temples and monasteries in the were destroyed - maybe because the monks and their patrons supported the rebels (Tennakoon Wimalananda: The Great Rebellion of 1818).

The histories of the monastic traditions of the *Amarapura Nikāya* and *Rāmañña Nikāya* stand testimony to the Buddhist revival activities of the period from 1800 to 1855 which fall into the early years of British Occupation. This paper argues that a unique tradition of art and architecture emerged in the Southern and Western Maritime Region under the influence of European taste and lifestyles. It seems that the aesthetics of the Elite in the South rejected all South Indian Influence inherited from the Kandyan Region (*Uda Rata*).

It is the earliest temples of the *Amarapura Nikāya*, that we discover the total rejection of the Kandyan Architecture. These temples like the temples in Ambagahaptiya (Balapitiya), Randonbe, Uturu Kalutara, Ambalangoda, Kumārakanda, Dodamdūwa, Ranvella, Kande Vihāraya all belong to the *Amarapura* fraternities. Some even today serve as the *Pārsrava Mōlasthānaya* (Head Quarters of the Fraternity). These new fraternities which were affiliated with the *Sangha* of Burma (*Amarapura* and *Hamsavati*) may have preferred to be disassociated with the Kandyan Chapters (*Malvatu* and *Asgiri*) which claim the tradition received from Siam. The best evidence is that Higher Ordination (*Upasampadā*) ceremonies since 1803 were held in the South with no participation of monks from the Kandyan Chapters.

**JINGLES OF AFRO-SRI LANKANS: AN ANALYSIS OF ‘MĀNJA’ AND THE
KAFFIRS’ SOCIAL IDENTITY
(BASED ON KAFFIRS SETTLED IN SIRAMBIADIYA, PUTTLAM DISTRICT)**

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Among a variety of social groups, Afro-Sri Lankans, known as Kaffirs, is a minor ethnic group resides in different regions of Sri Lanka. Although there are different opinions about their origin, according to available records, it can be assumed that these Kaffirs are descending from Africans who were given lands after disbanding the 3rd Ceylon Regiment, which comprised only Africans, in 1865. Today, in spite of the dissolving African genetic and cultural characteristics of Kaffirs, their unique music and energetic dance has become the primary agent of conveying their African genealogy to the outer world. Thus this research was carried out to answer the question that how Afro-Sri Lankans’ everyday life music called *Mānja* is accentuated to sustain their social identity.

Explaining social identity, J.E. Steta, and P.J. Burke state that social group is a collective of identical individuals all of whom identify themselves in equivalent ways and hold similar viewpoints, which contrast to out-group members. Thus the foremost concern of collectivism of Kaffirs, which represent Kaffirs’ identity as a separate social group, is African genetic features. Yet they are rapidly declining in the present due to intermarriages with non-Kaffirs. Under this condition, their everyday life music-*Mānja*, which was the cultural feature that is shared by Kaffir in-group members, is reformed to convey their ancestry. Formerly, the *Mānja* music, as a primitive form of music consisting similar melodies and smaller versus in songs, was the entertainment of Kaffirs’ everyday life. Since such day-to-day musical entertaining practices are not common among Sri Lankan culture, the *Mānja* music was identified as a specific cultural practice of a distinct social group. Accordingly the music is refashioned enabling Kaffirs to perform in a performance space exposing their African lineage to outer audiences, though some of the in-group members do not bear African genetic features. As opposed to the use of disposable coconut shells, a wooden board, a glass bottle, a coin, two spoons with *Dholak* or *Raban*, which are used to keep up the rhythm and the beat of music, Kaffirs now employ well-polished and well-maintained coconut shells etc., and colourful attires to achieve a greater attraction of out-group members for the *Mānja* music and dance performance. According to Kaffir members, *Mānja* music performances enabled outsiders to visit their village *Sirambiadiya* and to witness more music and dance in Kaffirs’ living setting, which emphasised their identity as a group. Despite few western musical instruments that accompanied song melodies, their recorded album, launched in 2011, named *Cafre Sthrela*, which comprised lyrics in creole language, is also a further step to disseminate their social identity intensifying the difference between them and other social groups.

After analysing the data gained over interviews, written sources and field visits to *Sirambiadiya* nearly seven years, it is apparent that uplifting the outsiders’ interest towards *Mānja* music not only enhanced the popularity of Kaffirs’ music but also highlighted Kaffirs as a distinct social group. Therefore it can be concluded that, even every Kaffir member does not bear African genetic features, today, *Mānja* music has become the major channel of communicating their social identity as Afro-Sri Lankans.

Not Presented

IMPACT OF INTRINSIC AND EXTRINSIC MOTIVATION ON DIGITAL REPOSITORY USAGE BY UNDERGRADUATES

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Digital Repositories (DR) are becoming more common in library and information centers throughout the world. However, there may be unanswered questions regarding their usage in particular from user perspective. With this current growth in digital repositories, it is useful to assess how users accept digital repositories for their learning and research. Assessing the user requirements would help to address the effective utilization of DR in a productive way.

This study attempted to investigate how undergraduates accept the digital repositories and to what extent extrinsic and intrinsic factors affect the undergraduates' digital repository usage with the application of extended theory of Technology Acceptance Model.

The study applied the extended Technology Acceptance Model (TAM) which explains extrinsic factors of perceived usefulness and perceived ease of use and incorporated the intrinsic factors of perceived enjoyment and concentration in order to predict the acceptance of DR by undergraduates.

The study used survey research design and data collected from 610 undergraduates of social science and humanities faculties in three universities in Sri Lanka by using stratified sampling method. The questionnaire was used to collect data and the survey yielded 538 usable questionnaires, with a response rate of 88%. Data was analyzed by using SPSS and model estimation was performed by using Structural Equation Modeling.

The study results indicated that perceived enjoyment and perceived ease of use have indicated strong direct effect on behavioral intention to use of DR. Perceived usefulness did not indicated strong effect on behavioral intention to use DR directly. User concentration posited that significant influence on behavioral intention to use DR mediated through perceived usefulness. Perceived enjoyment and perceived ease of use are found to be key drivers for the adoption and usage of DR.

The findings highlight that library managers should try to introduce DR as ease of use and fun activity to undergraduates. To build the pleasure of accessing DR resources, library managers should find innovative methods when introducing their services. Undergraduates are like to use and adopt the DR if they find that can facilitate their learning process and helping them to make ease of use and understand the usefulness of the resources.

THE COLLABORATIVE PROCESS OF TRANSCREATING SUBHA

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In current theories of theatre and translation, there is a tendency to view the translator as an individual who is not directly connected to process of creating the performance. In doing so, they often ignore other modes of translation, especially those that entail a group of people working together to generate meaning. In this paper, we intend to question the division established between translators, directors, and performers and speak of the possibility of all of these players coming together to create a theatrical translation together. In doing so, we do not wish to undermine the place of an individual translator, but to illustrate that a community translational model in fact functions in certain performance spaces. We propose to explore this question by analyzing the process of creating *Subha*, an experimental multimedia and movement play based on Rabindranath Tagore's short story, "Subha" and several poems from *Gitanjali*. *Subha* was produced by the department of Fine Arts in 2013 and subsequently staged in Shanthinikethan, Kolkata, India in 2014.

"Subha" is the story of a young girl who cannot speak and is marginalized by her family and society as a result. No one pays attention to her when she tries to communicate. With our play, we were trying to communicate Subha's reality, her silence and the depth of her silence. In order to do so, we had to find a different language, a different system of gestures, movement, silence, and sound. It was not the language we were used to. It was a language, a sign system that was able to capture the movement of nature that Subha so relishes. The communication thus happened with hands, fingers, and eyes. It happened with movement, music, sounds, and silences. What we strived to do in the production was to illustrate the different ways in which Subha communicated using all these theatrical devices, music, and video.

Rather than start with a predetermined, fixed text, devised theatre opens up the possibility of creating the script during the process. Here, we were not only grappling with multiple translators, but also with texts that moved between multiple genres. As we experimented with Tagore's texts, some words turned into movement and some became silent. What we propose to explore in this paper is the multiple modes of translation that takes place in the theatrical/ rehearsal space by speaking about our experiences of the process of devising *Subha* as the director and the music director of the piece. Through this example of a collaborative translation taking place in a rehearsal space, we will examine how we encountered a community model of translation and how we entered a space in which bodies, sounds, and movements were used to creatively transcreate the source text.

PROFILE PICTURE AND SEXUAL STIMULATION ON FACEBOOK AMONG UNIVERSITY STUDENTS

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The technological development has modified transfigure of human interactions. Especially, mediated technologies have changed the traditional mode of face to face interactions into new form of sender-receiver interactions with more digital applications. Facebook (FB) is one of the largest and popular social networking sites in digital world that has expanded all over the world in an allurement manner among the people of all generations particularly, youth.

Studies on youth and FB revealed that its usage pattern, motives to use FB in relation to social capital; Effects on higher education; Media habits; Psychological stress and health; Interpersonal relationships. These studies were limited to specific areas of FB: Social usage and its effects. In such a background, this study sought to determine the profile picture and sexual stimulation on FB among university students; with special reference to the University of Peradeniya. An operational definition for the study was used due to the complexity and diversity of terminology used in sexual stimulations. 20 case studies consist of 11 male students and nine female are analyzed using snowball sampling technique.

The study revealed that the undergraduates used FB profile picture as a tool to exchange sexual stimulations which gives the first impression of the FB counter partner within very few seconds. They get attracted towards counter party by looking at their profile picture whereas, giving interpretations and evaluations. Students perceived different responses at the end of FB interaction in relation to profile picture and all of them were heterosexual. From that majority of male students engaged in behavioral intimacies with outside females whereas female students victimized by direct and indirect sexual requests directed males apropos to FB profile picture. Although few male students used fake FB accounts, majority of them used their real accounts to exchange sexual stimulations using profile picture. Nevertheless, female students used real FB accounts in their interactions.

These findings reflect the way of how youth uses digital technology to gratify their need of sex using FB profile picture, inside the culturally covert society. Hence, the study suggests the necessity of providing awareness on digital media usage among youth to reduce the negative impacts that would be resulted in their future life.

A COMPARATIVE STUDY OF *DHAMMA* AND *LUCRETIUS' NATURA*

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The Buddhist term *dhamma*, denoting nature and the universal principle that governs the universe, scrutinizes its cause and effect and offers the ultimate solution to human suffering – the true nature of the universe. A few centuries later in Rome Lucretius proposes *natura*, a concept analogous to Buddhist *dhamma* that connotes the nature of the universe and its cause and effect, the invisible principles of its governance reflected in the visible natural phenomena. Both the Buddhist and Latin terms signify essentially the one and the same natural environment and its inner workings and, at the same time highlight the natural environment as the unfailing source of deliverance from life's suffering and fear.

This paper compares Lucretius' *natura* and the Buddha's *dhamma* as the natural law that highlights the connection between human life, experience, ignorance, suffering and deliverance from it. The study contends that the similarities between a classical Latin poetic work from the first century BCE that fulfills a didactic purpose by explaining the true nature of the universe, and the Buddha's *dhamma* that shows the path to deliverance from suffering (*dhukka*) in this world through the discovery of the true nature of the universe is too compelling to ignore. The argument is presented primarily through a close comparison of the relevant sections in Latin of Lucretius' *De Rerum Natura* and, references to *dhamma* in Pali texts, which will be substantiated with secondary sources.

Among the comparisons, purpose is foremost. Lucretius' purpose is to delineate the true nature and the inner workings of the visible world in order to distinguish between truth and superstition and thereby rescue the superstitious minds from the fear of death and of the gods. This rational and scientific account of *natura*, the governing principle of the universe, is at times the sum of the natural law governing the world, its personified teacher, the natural environment that is visible to the eye, and at other times, the very words Lucretius uses to teach *natura*. Being the true nature of the world, the understanding of which will lead to deliverance from suffering, the *dhamma* is connected with an austere purpose and also denotes the teachings of the Buddha himself. Thus *natura* and *dhamma* reinforce the potential of the natural environment to deliver the humanity (irrespective of nationality and religion) from suffering and the fear of the unknown.

Based on the above, this study will conclude that Lucretius' exposition of *natura* and the Buddha's *dhamma* as the natural law that governs the universe at large is similar in their mission of focusing on the Nature as the source of deliverance from all human suffering.

STREAM CORRIDORS ENCROACHMENTS AND ITS CONSEQUENCES: CASE OF PINGA OYA TRIBUTARY IN UPPER MAHAWELI RIVER SRI LANKA

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Expanding human interference towards the stream corridor ecosystems is creating many negative impacts for the environment in different scales. Identification of such interference and its consequences on reservation corridors in Pinga Oya in Upper Mahaweli tributary in Sri Lanka is the main objective of this research. Relevant literature, legal documents, field observations, stream cross sectional survey and questionnaire survey helped to analyze the problem. The study reveals that provision of the law related to the stream reservation in 1935 misuse in different scales in urban rural gradient of the Pinga Oya. In corridor scale within 40 m buffer to the stream total encroached imperviousness area was 42% and it includes residential, commercial buildings (30%) and government infrastructure developments (roads 9%, paved area 3%). Encroachment has negatively affected the river course due to channelizing the stream path and concreted flood plains, which resulted in flash floods, disturbances to riparian vegetation, negative changes of stream water quality and wellbeing of the stream dwellers. The problem is common in many urban stream corridors in the Upper Mahaweli catchment as well as other stream corridors in Sri Lanka. To overcome the major problem in stream corridors, the government should give more power to relevant authorities to take legal actions to demarcate the stream corridors of at least streams in urban premises. The process will be difficult but awareness will be much benefitting.

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**GENDER BASED DISCRIMINATIONS IN HIGHER EDUCATIONAL
INSTITUTIONS: A STUDY BASED ON
SOUTH EASTERN UNIVERSITY OF SRI LANKA**

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Women are exposed to gender based discriminations to a much higher degree than men in their work and study environments. The legal system and the cultural norms often treat it not as a crime. Though student composition contains more percentage of female students; the student union, Muslim Majlis , etc. have almost all the members male except one or two member who are sleeping members. In the name of the Islamic culture students are controlled within the university premises. The administrative system too from bottom to top has the male dominance and contains patriarchal ideologies. The problem and the real interest of the research is derived through direct encounter at the study area and this situation is considered as much interesting since the researcher entered to the field as a new person with differ cultural experience.

This study was conducted to determine the gender based discriminations prevails at the South Eastern University of Sri Lanka was the main objective. It was conducted among 50 students who have spent three years or more in the university using informal interviews and purposive sampling method. The study was more qualitative and most of the data are collected through narratives and storytelling of incidents.

The contained the data collection from all ethnic groups and interviews with administrative bodies gave more fruitful data. 65% of the sample was female. Almost all the respondents revealed that they have experienced discriminations based on their gender.

The result reveals that incidents such as intimidation, forced to commence romantic relationship, barrier to be involved in sports activities, barriers to participate in the cultural shows and competitions, restriction in dress selection, restriction in the way of dressing styles, having friendship with boys, etc. are some of the main findings. Incidents of intimidation, punishments, social exclusion, labeling has reported. More than discriminations, sexual violence as a bribe has also found in the research. It was found that the institution is very soaked in the broader cultural influences of the region and it is asked to be followed by the students by force.

**ISSUES IN RESTORING NORMALCY IN THE POST-WAR CONTEXT:
A SOCIOLOGICAL STUDY BASED IN THE BORDER VILLAGES IN
THE VAVUNIYA DIVISIONAL SECRETARIAT DIVISION IN THE
VAVUNIYA DISTRICT**

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In the post-war years, resettled people in the Northern and Eastern provinces faced many challenges when trying to restoring normalcy in their lives. This research was conducted in three selected *Grama Niladhari* (GN) Divisions, namely, Semamadhu, Illamaruthankulam and Kallikkulam. These three villages are identified as 'Border Villages'. The main aim of this research was to identify the challenge and barriers to resettlement and the return of normalcy in the war-ravaged areas. The study utilized both qualitative and quantitative data. In this research, 125 families were randomly selected from the three GN Divisions for the questionnaire survey. Qualitative data were collected through direct observations, key informant interviews, focus group discussions, case studies and participatory research methods. The overall findings of this research demonstrates that the people residing the border villages of the Vavuniya Divisional Secretariat in the Vavuniya District encounter many challenges in rebuilding their day-to-day life after the prolonged armed conflict. In the post-war context, resettled people from the border villages consequently face many problems to return to normalcy. After resettlement, people encounter several difficulties particularly, poor housing and sanitation, destruction of livelihoods, poor infrastructure facilities and poor access to services, such as, healthcare, banking, postal, insurance, education, transportation and public services. The Government of Sri Lanka, International Organizations, Non-Governmental Organizations and Civil Society should work together to restore normalcy in the lives of the resettled people in the war-affected areas of Sri Lanka. The study also recommends that more research work on war-affected people should be carried out.

AN EXPOSITION OF ETHICAL PREREQUISITES FOR MIND DEVELOPMENT

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Moral training, the first constituent of the threefold training (*sīla, samādhī* and *paññā*) designated in Buddhism is the foundation of the entire practice that serves as a prerequisite for mind development. The threefold Right Conduct (in body, speech and thought) as elaborated in *Saṅgīti Sutta, CundaKammāraputta Sutta, SāleyyakaSutta*, etc. is the major ethical prerequisite that forms the principal basis for mind development.

The scrupulous observance of the precepts for the laity and the *pātimokkha* for the ordained provides grounds to avoid inimical physical and verbal misconduct which nourishes the Five Hindrances (*pañcānīvaraṇa*). The restraint of bodily and verbal activities leads to weaken the external detrimental forces that hinder the practice. The other ethical prerequisites entail a simple life with a fewness of wishes, satisfaction (*santussako*), a light living (*sallahukavutti*) with few duties (*appakicco*), less attachment and less craving, a balanced livelihood (*sama-jīvikatā*) with persistent effort (*uṭṭhāna-sampadā*), the accomplishment of watchfulness (*āraḁkha-sampadā*), good friendship (*kalyāṇamittatā*) and right livelihood (*sammājīva*) which refers to the engagement in wholesome occupations are mandatory prerequisites which make one's mind highly receptive and malleable for the initiation and the progress of mind development.

The purification of morality endowed with psychological strength such as non-remorse, joy and rapture, etc., helps a meditator to remain psychologically undisturbed and inwardly calm and maintain concentration during the practice.

Thus, the observance of the moral discipline reinforces the outward suppression of harmful mental factors and in turn helps one to suppress the inward malign mental factors that hinder concentration and mindfulness. As a whole, moral restraint and moral purity which establishes sound outward conditions which are conducive to inward progress is an obligatory ethical prerequisite for a thriving initiation of mental development.

LEGAL FRAMEWORK FOR THE PROTECTION OF GEOGRAPHICAL INDICATIONS IN SRI LANKA

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Giving protection to Geographical Indication (GI) to the products emerges as a serious concern to developing countries in the post - TRIPS (Agreement on Trade Related Aspects of Intellectual Property Rights) context. A GI is a sign belonging to a place of origin of goods because of which the goods possesses specific qualities, reputation or characteristics. GIs need to be protected because the product derives its qualities and reputation from that place. If GIs are not protected, there is a possibility to misrepresent the customers to believe that they buy a genuine product with specific qualities and characteristics. As a result, reputation of genuine sign of GI and reputation of the place originated may be spoiled among customers due to imitation of signs and it may encourage unfair competition in trade.

In the present context, GIs are protected under the category of intellectual property rights internationally and nationally under wide range of concepts such as special laws for the protection of GIs or appellations of origin, protection of patents, protection of trademarks in the form of collective marks or certification marks, laws against unfair competition in trade, consumer protection laws and specific laws or decrees that recognize individual GIs. In international arena, there are some treaties and conventions governing and regulating the way of protection for GIs. Presently, so many countries have amended their laws in connection with the protection of GIs especially developing countries. However it is realized that the protection for GIs in Sri Lanka is inadequate due to narrow scope of legal framework for GIs. Therefore, the special law of Sri Lanka for GIs has to be extended the scope of protection for GIs in order to prevent the theft of GI product of Sri Lanka and to strengthen the protection of GIs. For this purpose, the study intends to propose the most suitable legal framework for the protection of GIs in Sri Lanka by way of comparative analysis with some other countries.

The study concludes from the comparative analysis of other countries that Sri Lanka should bring substantial changes to the GI laws under the Intellectual Property Act No 36 of 2003. Those changes are comprehensive definition for GIs which should include manufactured goods eg: painting and garments etc, protection through registration of GIs in addition to unregistered GIs, extending the role of National Intellectual Property Office for GI protection, action for infringement of GI protection and remedies for infringements.