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Towards Transdisciplinary Research Culture

Abstracts of Presentations

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Evaluation of anti-histamine and membrane stabilization potentials on red blood cells of acetone extract of *Pleurotus ostreatus*

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We have reported the anti-inflammatory activity of *Pleurotus ostreatus* using carrageenan induced rat paw edema model. This study evaluates anti-histamine and membrane stabilization potentials of acetone extract (AE) of *P. ostreatus*. Rats were assigned to three groups, and fur on the left posterior lateral side was removed. After 24 hours, rats were treated with AE (500mg/kg), chlorpheniramine (0.67mg/kg) and distilled water respectively. After 1 hour, histamine (50µLof 200µg/mL) was subcutaneously injected to the shaven area and the area of the wheal formed was determined after 2 minutes. A ten-fold dilution series ranging from 0.001 to 1000µg/mL of AE and aspirin was made using phosphate buffered saline (PBS) whereas PBS was the control. The vials containing rat blood and different concentrations of AE, aspirin and PBS (1mL each) were incubated at 37°C and centrifuged. The supernatants were removed and the cells were resuspended in PBS and incubated at 54°C, centrifuged and optical density (OD) of supernatants was measured at 540 nm. Percent inhibition of haemolysis was calculated with respect to the controls. Oral treatment with *P. ostreatus* and chlorpheniramine significantly ($p<0.0001$) reduced the area of wheal formed (52.1±1.1% and 57.9±1.5% respectively) on the skin. All dilutions of *P. ostreatus* except 0.001µg/mL (lowest) significantly inhibited the heat-induced haemolysis of rat erythrocytes *in vitro* indicating membrane stabilizing activity. Protection against heat-induced lysis of RBC is often extrapolated to stabilization of lysosomal membranes, and used as a measure of anti-inflammatory activity. Therefore, the ability of *P. ostreatus* to protect RBC against heat-induced lysis indicates its ability to stabilize the lysosomal membrane and thereby inhibit the inflammation. Therefore, anti-histamine and membrane stabilizing activities may contribute as possible mechanisms of anti-inflammatory activity of *P. ostreatus.*

Key words: *Pleurotus ostreatus*, anti-inflammatory, antihistamine, membrane stabilization

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Prevalence of Obstructive Sleep Apnea risk among public transport bus drivers in Jaffna, Sri Lanka

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Obstructive sleep apnea Syndrome (OSAS) is a common disease associated with daytime sleepiness. OSAS is characterized by instability of the upper airway during sleep, which results in markedly reduced (hypopnea) or absence of (apnea) airflow at the nose and or mouth with accompanying de-saturation of oxy-hemoglobin. The objective of this study is to investigate the prevalence of obstructive sleep apnea syndrome (OSAS) risk among public transport bus drivers in Jaffna district Sri Lanka. Descriptive cross sectional study was done among public transport bus drivers (n=267) of both state and private sector. Stratified random sampling method was used. Interviewer-administered questionnaire and a check list were used to collect data in a survey. The prevalence of OSAS risk was estimated using the Berlin questionnaire. Mean age of study participants was 40.2 years and mean BMI was 24.8. The prevalence of Obstructive sleep apnea risk was 11.6% and the prevalence of self-reported snoring was 28.5%. Percentage reported cases of falling asleep while driving was 24.7% among drivers. The following variables were found to be in significant association with OSAS in chi-square test: Smoking (40.4%, $p=0.034$), alcoholism (38.2%, $p=0.010$) and obesity measures like neck circumference (4.5%, $p<0.0001$) and waist circumference (36.7%, $p=0.031$). The risk of OSAS had statistically significant positive correlation with systolic blood pressure ($r=0.5$, $p<0.001$) and diastolic blood pressure ($r=0.416$, $p<0.001$). Age of the drivers and betel chewing were not statistically significant associated with OSAS risk. The results conclude that 11.6% of the public driver population is at high risk for OSAS and day time sleepiness. So the relevant authorities have to consider this and it need further community based studies.

Key words: Obstructive Sleep Apnea Syndrome, blood pressure

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Study of fasting plasma glucose levels in non-diabetic subjects related to selected risk factors for type 2 diabetes

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Diabetes is a preventable but a non-curable disease, which is influenced by socio-economic status, sedentary lifestyle and genetic factors of individuals. Hence, the objective of this study was to identify the association between fasting plasma glucose (FPG) with socio-demographic status, family history and lifestyle habits in non-diabetic subjects. A cross-sectional study was conducted in 227 non-diabetic subjects after obtaining ethical approval. FPG was measured using a Glucose Oxidase kit method after an overnight fast. An interviewer-administered questionnaire was used to collect information on socio-demographic factors, family history of diabetes and lifestyle habits. Correlations and differences were analysed using SPSS (ver.17) software. Among 227 subjects 59.9% were females. Majority of them had secondary and tertiary education (90.7%) with the monthly income of more than Rs. 25000 (70.5%). Among the subjects, 10.1% were detected as pre-diabetics (FPG 5.6-6.9 mM/L) and 47.6% had a family history of diabetes. Out of pre-diabetics, 65.2% had familial diabetes. Furthermore, 82.6% of pre-diabetics had monthly income of more than Rs. 25000, and those who had high income also had a higher mean FPG. FPG significantly correlated with age. Subjects older than 35 years had higher significant mean FPG ($p<0.01$). Significant difference was observed with FPG for gender and sleeping duration of more than 6 hours per day ($p<0.01$). Negative correlations were observed with vigorous, moderate and walking activities as well as sleeping at night ($p>0.05$). This study suggests that age, higher household income, family history of diabetes and short sleep are associated with increase in FPG.

Keywords: Fasting plasma glucose, pre-diabetes, household income

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Association of C-reactive protein concentration with weight of patients awaiting Coronary Artery Bypass Graft (CABG)

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Proportional mortality for Cardiovascular Diseases (CVD) was 30% in Sri Lanka for all ages according to WHO. Overweight and obesity are defined risk factors for non-communicable diseases such as CVD. C-reactive protein (CRP) is an inflammatory marker and has an independent predictive value for CVD when within the clinically normal range. Most studies indicate an association of elevated CRP levels with overweight and obese due to low grade systemic inflammation. Most these observations are according to western anthropometric parameters and few reports related to South Asians exist. Therefore, the objective of this study was to investigate the association of CRP with weight of confirmed CVD patients (n=51) awaiting Coronary Artery Bypass Graft. The study population included 30 males (age 57±10.4 yrs) and 21 (age 56±9.5 yrs) females with no clinical signs of inflammation and infection. The weight, height and waist circumferences (WC) were measured and blood samples were collected to analyse serum CRP level by turbidimetric immunoassay. Body Mass Index (BMI) was calculated and the subjects were identified based on BMI values defined for Asians by the WHO as being overweight (≥23 kg/m^2) or non-overweight (<23 kg/m^2) or obese (≥25 kg/m^2). CRP of the study group ranged between 0.4–14.5 mg/L. Depending on CRP concentration, the subjects were divided to two categories, <5mg/L and ≥5 mg/L. 70.6% individuals were either overweight or obese (47.1%). From the total population 84.3% of the subjects had <5mg/L CRP. There were positive correlations ($p<0.05$) between BMI and CRP concentration when considering the total group ($r=0.420$), the overweight group ($r=0.476$) and the obese group ($r= 0.563$). A negative correlation was observed when considering the subjects who had BMI <23 with their CRP ($r=-0.121$, $p>0.05$). Significant correlations between WC and CRP concentration ($r=0.356$, $p<0.05$) of the total subjects and the overweight subjects ($r=0.370$, $p<0.05$) were also observed. Although not significant, the WC of obese correlated positively with CRP ($r=0.316$, $p>0.05$). The odd ratios of overweight and obese with elevated CRP were 3.37 (95% CI: 0.37–30.20) and 4.17 (95% CI: 0.75–23.06) respectively. The results thus indicate overweight and obese patients with confirmed CVD have a threefold and a fourfold high risk of having elevated CRP respectively. BMI and waist circumference (central obesity) had positive correlations with CRP in overweight and obese CVD patients.

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Branching pattern of Inferior thyroid artery and its relationship to the recurrent laryngeal nerve in Sri Lankans

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Careful study of position of terminal branches of inferior thyroid artery (ITA) in relation to recurrent laryngeal nerve (RLN) is required for safe thyroid surgery. Generally ITA divides and enters middle or lower portion of the thyroid. Near the lower pole, RLN is always intimately related or positioned with ITA. Previous studies have documented possible ethnic and gender variation with reference to origin and branching pattern of ITA. This study was conducted to determine anatomical variations in branches of ITA and its relation with RLN in fresh post-mortems conducted at Judicial Medical Office, Colombo South Teaching Hospital. Fifty thyroid samples (36 males and 14 females) without thyroid diseases were taken. Total of 42 left (L) and 38 right (R) were studied for relationship between ITA and RLN and remaining sides either ITA or RLN was damaged. Three types of positioning were recognized: RLN passing posterior to ITA or its branches (Type A: 64%), RLN passing anterior to ITA or its branches (Type B: 16%) and RLN passing in between branches (Type C: 20%). Total of 34(L) and 31(R) were studied for entering pattern of ITA, 52% entered into middle and 48% into lower portion. Total of 39(L) and 40(R) were studied microscopically for terminal branches with 2 branches present in 57%, 3 branches in 42% and 4 branches in 1%. This study revealed that Type A was predominant in both genders and ITA divides into 2 or more branches as similar with Asians and Americans in other documented studies. Most of ITA enters into middle lobe and type B was more common in females.

Key words: Inferior thyroid artery, recurrent laryngeal nerve, relations, thyroidectomy

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The distribution of somatotypes and sexual dimorphism among a selected group of young Sinhalese adults

L.H.L.C. De Silva[1], H.M.I.U. Herath[1], W.L.N.S. Samaranayake[1], S.I. Jayasinghe[1], P.P.C.K. Gunawardena[1], A.P.H.M. Ariyawansha[1], K.K. Wijeyarathne[1], M.A.M. Azam[1], A.A.H. Supunda[1], A.K.P. Rathnayake[1] and J.K. Dissanayake[2]*

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Composition of the body changes with level of physical activity, gender nutrition and genetic factors etc. It is important to understand these aspects of human constitution as it shows relationships with disease conditions, physical performance and behaviour. Somatotype is a measure of physique of the body at present. Research has shown that this is a better indicator of body composition than indicators such as body mass index. It quantifies and categorise the present shape and composition of human body in to three components namely endomorphy or the level of fatness, measomorphy or the development of the musculoskeletal compartment and ectomorphy or the linearity of the body. As such distribution of somatotype of a population reflects the activity level, physical performance tendencies, disease preponderance and predisposition. This study was carried out to verify the distribution of somatotypes among a group of Sinhalese Medical students who were not suffering from any chronic illnesses, not under medical surveillance, haven't got any physical deformity. Consecutive sampling helped to select 103 males and 97 females. Somatotype of this group was determined according to the method described by J.E.L. Carter in 2002. The age distribution of the study group was 20-26 years. Of the three somatotype components studied, endomorphy was dominant among female students whereas males had a physique with a balance in all three components. Compared to evidence provided by previous studies, it is concluded that body composition of females of this study reflects a low level of physical activity. In relation to somatotype and individual anthropometric measurements, a significant sexual dimorphism was demonstrated.

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Influence of body weight, gender and milking interval on venom yield of scorpion *Heterometrus swammerdami* (Simon 1872) (Scorpionidae) from Jaffna peninsula

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Scorpion venom contains many biologically and medically important compounds. Thus there is a strong demand to obtain venom from various species of scorpions for research purposes. Objective of the present study is to determine the optimal conditions for scorpion *Heterometrus swammerdami* (Simon 1872) in order to maximize venom yield available for research. Scorpions were collected from Thirunelvely in Jaffna. Morphological identification of the collected scorpions was done employing identification keys. All scorpions were maintained alive in the laboratory in individual glass tanks and fed with 1-3 cockroaches once a week. Venom was collected by using electrical stimulation (5- volts) of the telson for a period of 5-10 seconds. The body weight of scorpion and wet weight of venom were weighed. In total, 170 rounds of milking were carried out using 50 individual *H. Swammerdami* (25 female, 25 male). Collected venom was stored at -20°C until further use. All statistical tests were analysed by using ANOVA. Gender and body weight were found to cause a major effect on the venom yield. Male scorpion yielded significantly less ($p<0.05$) venom (3.7 ± 0.51 mg) than female scorpion (4.0 ± 0.07 mg). However, venom yield correlated linearly with scorpion weight for scorpion weighing up to 25g with maximum yield 4.0 ± 0.20 mg. Furthermore, a significant reduction (2.5 ± 0.02 mg; $p<0.0001$) in the venom yield was found during two week time interval. On the other hand, starvation and state of nutrition did not significantly affect ($p>0.05$) the venom yield. These findings can reveal the optimal condition to increase the venom yield and lead the field of venom research.

Key words: *Heterometrus swammerdami*, milking of venom, scorpion venom

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Comparison of soil-dwelling insect fauna in eco-friendly versus conventional home gardens at selected localities in Hambanthota District

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Soil-dwelling insects are a major component of the soil ecosystem and play a key role in nutrient recycling and natural suppression of insect populations. Advanced technology and extensive synthetic inputs such as pesticides and fertilizers used in agriculture exert negative impact on biodiversity. The soil insects associated with agricultural and natural fields have been poorly studied locally; therefore, present study was conducted to compare the soil-dwelling insect fauna in conventional and eco-friendly home gardens located in Kumaragama, Katuwanayaya and Elisonkanda in the Hambanthota District. In each village, insect fauna were sampled using pitfall traps from four fields each in eco-friendly home gardens and in conventional home gardens, and species abundance, species richness and species diversity were compared among locations and between two management systems. A total of 2433 individuals were collected, belonging to six orders and 15 families. Insect abundance was significantly higher in eco-friendly home gardens (χ^2=18.61, df=5, P<0.001) compared to conventional home gardens. Significant difference in insect abundance among different orders was also observed (χ^2=18.612, df=5, P<0.001), where in both systems, order Hymenoptera was the most abundant group followed by Coleoptera, Orthoptera and Hemiptera. Species richness (S) was high in eco-friendly home gardens (S=40) than conventional home gardens (S=37). Diversity of ground dwelling insects was much higher in eco-friendly home gardens: Coleoptera (Diversity index, H'=0.48), Hemiptera (H'=0.32), Orthoptera (H'=0.26), Hymenoptera (H'=0.31) and Dermaptera (H'=0.19). Insect abundance was also significantly different among the three villages (χ^2= 88.24, df=2, p<0.001) and highest insect abundance was recorded in Kumaragama (N=666). It was revealed that there is a general trend of promoting ground-dwelling insects in eco-friendly home gardens possibly due to the effects of management practices.

Key words: Biodiversity, ground-dwelling insects, Hambanthota, home gardens

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Prevalence of ticks and tick-borne blood parasites in selected cattle farms in Mirigama veterinary range in Sri Lanka

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Ticks and tick-borne blood parasitic infections are a major problem in livestock management. These infections result weight losses, reduction in growth and dairy production, high cost for drugs and veterinary care. The present study was carried out to identify the prevalence of ticks and tick-borne blood parasites on dairy cattle in three locations namely, Kahambiliyawatta (free range farming), Malingamuwa (semi-intensive farming) and Ullalapola (intensive farming), in Mirigama veterinary range of Gampaha district, Sri Lanka. In studied cattle (n=80), the most abundant tick genus was a hard tick belonging to genus *Boophilus*. The mean tick abundance values were ranked as high (n>15), moderate (5–15) and low (n<5). Tick abundance was high in Kahambiliyawaththa farm (42.2 ± 4.54), moderate in Malingamuwa farm (13.8 ± 0.952) and low in Ullalapola farm (3.6±0.581). There was a significant statistical difference (χ^2=15.893, p<0.001) in tick borne blood parasitic infection in cattle among the studied farms. Among the studied cattle, *Theileria sp.* was found in all three study sites and its percentage prevalence was 24% while for *Babesia bigemina*, it was 22% and only recorded in Kahambiliyawaththa and Ullalapola farms. *Ehrlichia bovis* had the lowest prevalence (1%) and found only in Ullalapola farm. The present study reveals that the prevalence of tick-borne blood parasites is different among three selected locations. Further, the severity of the tick infestation on the body of cattle does not reflect the extent of the infection of tick-borne blood parasites in the host.

Key words: Dairy cattle, *Boophilus, Theileria, Babesia bigemina, Ehrlichia bovis*

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Successes and failures of inland fisheries management in Ridiyagama Reservoir in Ambalantota, Sri Lanka

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Inland fishery is a common pool which is potentially subject to resource degradation if over-exploited. Therefore, a proper resource management is essential for its sustainable resource use and development. Community Based Organizations (CBO) in terms of participatory approach is formed within the village communities to address the management problems. Primary purpose of this research was to examine the successes and failures of Ridiyagama CBO when managing inland fisheries in Ridiyagama reservoir, Ambalantota. This study specifically investigated the fisher-folk perceptions towards the fishery resource status in Ridiyagama reservoir while examining the role of existing CBO for a sustainable fisheries management in the reservoir. Following an interview based approach, a convenience sample of 38 fishermen was selected and relevant information were gathered using a structured questionnaire. The data were analyzed using SPSS 13.0 software by performing descriptive analysis and non-parametric statistics such as Wilcoxon signed rank test. According to the perceptions of the fisher-folk, fishery resource in Ridiyagama reservoir is in a declining stage. The CBO of Ridiyagama reservoir has been successful in stocking fingerlings, record keeping and maintaining sound relationship with the government in managing the inland fisheries. Nevertheless, it has failed to address the prevailing key issues of illegal fishing and encroachment due to improper implementation of Input and Output control mechanisms. Therefore, taking actions to minimize the functional weaknesses of Ridiyagama CBO is of paramount importance to uplift the sustainable management of Ridiyagama inland fisheries.

Key words: Community based organizations, illegal fishing, inland fisheries, input and output control, Ridiyagama reservoir

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Production of simulated caviar using readily available freshwater fish species *Cirrhinus mrigala*

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Simulated caviar, also named as imitation caviar is defined as salted roe that comes from a fish other than the sturgeon, and can be classified as a caviar substitute. Fish roe is removed as a by-product and does not have a high demand at present. Therefore, it is important to add value to fish roe which is of low demand. As a commercially significant freshwater fish species in inland fishery sector, Mrigal (*Cirrhinus mrigala*) was selected as resource fish species for present study. In this study, intention was to investigate most suitable methodology for production of simulated caviar using Mrigal roe. Roe samples of Mrigal were subjected to "Dry salting" method and three different salt (g): fish roe (g) ratios as 0.05:1 (S1), 0.25:1 (S2) and 0.45:1 (S3) were used to determine the best ratio. Most appropriate treatment was assessed using sensory evaluation, proximate analysis, pH test and microbiological analysis. Protein level of S1 and lipid contents of S3 samples are significantly different from those of other two samples. But highest protein content is recorded for S2 treatment, while maximum lipid percentage is recorded for S1 treatment. Moreover, moisture content of three samples was statistically different when compared to each other. pH values of three treatments changed significantly with storage time. Total Plate Count (TPC) was not changed significantly only in S3 with the time. Highest sum of rank for four sensory parameters (Aroma, Salty taste, Mouth feel and Overall acceptability) were recorded for S2 treatment. Moreover, as this treatment requires the intermediate salt concentration, it relatively reduces the production cost of the product. As it preserves highest protein value in final product, moderate salt requirement and best sensory qualities, S2 treatment (0.25 salt: 1 fish roe) can be considered as the best treatment for preparation of simulated caviar using Mrigal roe, among all three treatments.

Key words: Dry salting, fish products, imitation caviar, roe, sensory evaluation

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An assessment of heavy salting and salted drying on yield of Talang Queen (*Scomberoides commersonianus*) fish fillets

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Dried fish is one of the most popular protein sources among Sri Lankans. Current dried fish processing methods cause to reduce the yield by 1/2 of fresh fish fillets. Salting and drying methods lead to unfavourable effect on quality and safety of products by cross contaminations through wind, soil and animals. This study was planned to introduce heavy salting and compare with salted drying on yield, quality and safety of Talang Queen ('kattawa') dried fish which has higher demand in the local market. Prepared 'kattawa' fish fillets were separated in to two groups. First group was salted with excess amount of salt and stacked in a box which had drain outlet in the bottom and the second group was salted at 1:4 (salt to fish) ratio and stacked in a similar box. Both were kept in room temperature (31± 2˚C). After 24 hours, second group was directed to sun drying after removing and washing salt crystals on the surface of fillets. Drying of 'katawa' fillets continued until the water activity level reduced below the 0.75 while first group was kept in the same box for five days. Analyses were conducted for moisture, water activity, protein, salt and yield. Samples were collected form fresh fillets, after 24 hours, after four and five days. According to results, the level of water activity and salt content of both groups were not significantly different ($P>0.05$) at the end of the process. Yield of heavy salted 'kattawa' recorded 25% higher value than salted dried fillets. Heavy salting in a closed box assured the quality and safety preventing cross contaminations.

Key words: Cross contaminations, dried fish, sun drying

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Establishment of farmer operated, low cost, simple technology mini hatchery for Genetically Improved Farmed Tilapia (GIFT)

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Government hatcheries maintain the brood stocks of Genetically Improved Farmed Tilapia (GIFT) to supply fry and fingerlings for stocking programmes. The demand for fry cannot be fulfilled by the production of these hatcheries. To address this problem an experimental mini hatchery was established. A bricked hut (3m x 3m) with asbestos roofing, owned by a fisherman at Kattakaduwa, Hambantota was used as the hatchery. Water re-circulating system having an overhead tank (1000 L), ground level storing tank (1500 L), and two large gravel filters (25L) in order to filter the water entering and leaving the hatchery was established. Transparent plastic bottles (4L, 22cm in height) and plastic trays (40cm x 28cm x 4cm) were used as incubation jars. Inflow water was supplied to the bottom of the each bottle and 28cm side of the trays through 1.25 cm PVC pipe. Outflow water was removed from the top of the bottle via a 2.5 cm pipe and through a series of holes pierced at the 40cm sides of the trays. Stocking density for eggs and yolk sac fry were 250/L. Different flow rates for incubation of eggs and for survival of yolk-sac fry were trialled. Plastic bottles were the best container for incubation of eggs resulting over 80% hatchability. Plastic trays proved the most suitable container (90% survival) for development of yolk sac larvae. Optimized flow rates were 2.7 L min^{-1} for egg incubation and 5.4 L min^{-1} for yolk-sac fry. Total cost for the hatchery was approximately Rs. 77000. As one hatchery cycle lasts for approximately 10 days, this cost is recoverable in few rounds of hatchery cycles. No high technology being involved in construction, this mini hatchery provides a suitable system for fry production for farmers to fulfil their own seed requirements.

Key words: GIFT eggs, hatchability, mini hatchery, survival rate, yolk sac larvae

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Evaluation of binders for Tilapia fish sausage production and shelf life evaluation in frozen storage

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Consumption of Tilapia (*Oreochromis niloticus*) is restricted due to its muddy flavour and odour. This study aims for the development of tilapia mince based pre-cooked sausage. However, as tilapia muscle tissues are more easily broken, improving the binding property is especially addressed in this study. Synergistic interaction between isolated soy protein (ISP), modified starch (Taric), red rice flour and white rice flour were tested with five combinations of binders. White rice flour (6%), ISP (2%) and Taric (0.5%) were selected as the best combination. That combination shows higher water holding capacity (58%) and lowest cooking losses (13%) after 20 days at -18°C. Accordingly, tilapia mince (60%), water (24%), palm oil (5%), binders (8.5%), spices (1.5%), and flavour enhancers (1.0%) were identified as the best ingredients composition. The most preferable spice mixture was red chilli, garlic, ginger, cinnamon, clove and black pepper that could eliminate the muddy flavour of tilapia. Proximate composition of tilapia sausage is 65% moisture, 34% total solid, 14% protein, 6% fat and 155 kcal/100g. Tilapia sausages were stored at -10°C, -15°C and -22°C for the accelerated shelf life testing and results indicated that 9 months of shelf life can be achieved for tilapia cooked sausage at -18°C. Results conclude that tilapia fish mince can be successfully utilized for preparation of acceptable and safer fish sausage with accessible price.

Key words: Binders, Tilapia sausage, shelf life, synergistic interaction, texture,

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Effect of dietary C18 PUFA on fillet Long Chain PUFA concentrations: A comparison between Murray cod and rainbow trout

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Substitution of fish oil with economical and environmental friendly terrestrial alternatives in aquafeed has drawn significant attention on a global scale. Nevertheless, alternative oils rich in C18 PUFA are known to modulate fatty acid metabolism in fish. The present study evaluated the effects of C18 polyunsaturated fatty acids (ALA+LA) on fatty acid metabolism and final fillet long chain PUFA concentrations in cold water rainbow trout and warm water Murray cod. Two separate sets of six isoproteic and isolipidic experimental diets using three different dietary lipid sources (sunflower oil, linseed oil, and beef tallow) were formulated with varying concentrations of total C18 PUFA (Murray cod: 7.3, 18.8, 29.8, 41.7, 51.7, 63.8 w/w%; rainbow trout: 9.1, 15.4, 29.0, 41.3, 54.0, 66.2 w/w%) maintaining a constant ratio (1:1) of ALA/LA, whereas fish oil was used for the control diet for each feeding trial for Murray cod and rainbow trout separately. Fish were fed twice daily at 8.00 a.m. and 4.00 p.m. to apparent satiation for a period of 133 days (M cod) and 91 days (trout). In Murray cod, fatty acid metabolism estimations demonstrated an increase in delta-6 desaturase activity acting on ALA over LA as the substrate availability increased, while the efficiency of delta-6 activity in rainbow trout was negatively affected by an increasing C18 PUFA content. However, total desaturase activity was directly proportional to total C18 PUFA content in rainbow trout. With the reduction of C18 PUFA, a shift in substrate preference of delta-6 activity was noted in Murray cod. Delta-6 activity on ALA was higher across all concentrations of C18 PUFA in rainbow trout. An increasing trend of delta-5 desaturase activity was noted in rainbow trout fed elevated C18 PUFA while no delta-5 activity was observed in Murray cod. Murray cod exhibited maximal delta-6 enzyme activity at an average C18 PUFA level, denoting that excessive C18 PUFA concentrations are counterproductive. This information provides a valuable insight into the formulation of eco-friendly, sustainable fish oil free aquafeed for different species.

Key words: α-linolenic acid (ALA), LC-PUFA, Linoleic acid (LA), Murray cod, Rainbow trout

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Rates of phosphorus on growth and yield of maize (*Zea mays* L.) in the dry zone of Sri Lanka

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Phosphorus (P) is an essential element for maize but many soils are low in forms that are readily available to plants to ensure satisfactory growth. A field research conducted during '*Maha'* (2012/2013) season at the research farm, Faculty of Agriculture, Rajarata University of Sri Lanka examined the effect of different rates of P on growth and yield parameters of maize (var. Sampath). The experimental plots were arranged in a Randomized Complete Block Design with four treatments and four replicates. The treatments were 0 (T1), 20 (T2), 30 (T3) and 40 (T4) kg of P ha^{-1}. Soil samples were obtained initially and at 4, 8, 10, 12, and 16 weeks after planting (WAP) and analyzed for pH, electrical conductivity (EC) and available P. Leaf samples obtained at 4, 8, 10 and 12 WAP were analyzed for total P. Soil pH, EC, available P and leaf P content were not significantly different (P<0.05) among treatments. Plant height at 50% tasseling stage and number of days to 50% tasseling were significantly higher (P<0.05) in T2 compared to other treatments. The number of cobs per plant, number of rows per cob and 100-grain weight were not significantly different among treatments while the number of kernels per row and number of grains per cob were significantly higher (P<0.05) in P treatments than the control. Application of 30 kg P ha^{-1} produced the highest grain yield of maize variety Sampath under the tested experimental conditions in the dry zone of Sri Lanka.

Key words: Grain yield, growth, maize (*Zea mays* L.), phosphorus

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Effects of different natural organic additives on *in vitro* regeneration of radish (*Raphanus sativus* L.) *Var.* Beeralu Rabu

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In vitro regeneration ability was greatly influenced by medium composition of culture media which deliver nutrients into *in vitro* plant growth as well as *in vivo* plant growth. In addition to inorganic salts, a carbon and energy source, vitamins, and plant growth regulators, in case of specific needs of particular species or tissues, other components, including organic nitrogen compounds, organic acids, and a wide variety of complex natural extracts, can be important. *Raphanus sativus* L. commonly known as 'radish' is a popular vegetable crop used by people all over the world for its culinary and medicinal properties. 'Beeralu' is a Sri Lankan radish variety which has been recommended for low country in Sri Lanka. Therefore, variety 'Beeralu' is needed to be subjected to further tissue culture studies. Hence, the present study was carried out initially to find out the effects of different organic additives on *in vitro* shoot regeneration of Radish (*Raphanus sativus* L.) *Var.* Beeralu. Hypocotyl explants of aseptic plantlets were cultured on MS basal medium (100ml) supplemented with 2.5mg/L Benzyl Adenine (BAP) and 0.1mg/L 1-Naphthaleneacetic Acid (NAA) and natural additives; rice flour (5g), grind potato tubers' juice (100g/20ml) H_2O, grind carrot juice (100g/20ml H_2O), orange juice (10g/100ml H_2O), green gram (10g/100ml H_2O) and control. Complete Randomized Design (CRD) with five replicates was used for the study. After one month, the numbers of regenerated shoots were counted and statistical analysis was carried out using the Student Newman-Kuells Means Separation Test of SAS program (9.1.3). Number of shoots which was gained by control treatment was 7 shoots/explant. The highest mean number of shoots (12 shoots/explant) from Radish *Var.* Beeralu was observed in MS basal medium with 2.5mg/LBAP and 0.1mg/LNAA supplemented with orange juice (10g/100ml H_2O). No shoots were (0 shoots/explant) observed from medium with carrot juice but it induced callus formation. Media with rice flour (6 shoots/explant), grind potato tubers and green gram (1shoot/explant) inhibit the shoot regeneration.

Key words: *In vitro* regeneration, natural additives, orange juice, *Raphunus sativus* L.

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Allelic diversity and seedling tolerance of some rice (*Oryza sativa*) germplasms under salt stress

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There are vast numbers of divergent rice germplasms in Sri Lanka. As the development of salinity tolerant cultivars has become a prioritized research area, it is necessary to assess these varieties and utilize them in breeding programs. Previously a major salinity tolerant QTL called *Saltol* 1 has been discovered in chromosome 1 of Pokkali derived germplams. Assessment of SSR markers at the region of *Saltol 1* QTL and phenotypic assessment of seedling stage of rice germplasms would give some insight into the understanding of salt tolerance. In this regard, we analyzed twenty rice germplasms, including traditional and improved varieties, with five SSR markers closely linked to *Saltol* 1. Also morphological traits of the seedlings were assessed under saline condition which was created with 100mM NaCl concentration (12 ds/m) in hydroponics. Results showed that root length, shoot length, fresh root weight, and dry root weight were significantly different among varieties. Survival index and visual injuries were exhibited that some traditional varieties and exotic varieties are extremely tolerant even than Pokkali, the well-known salt tolerant check variety. The dendrogram obtained from cluster analysis of DNA markers indicated that some of the tolerant varieties were grouped in separate clusters. Polymorphic banding patterns of SSR markers obtained from tolerant and susceptible varieties near *Saltol 1* would be useful in selecting parental lines for the rice improvement breeding programs designed for salt tolerance**.**

Key words: Rice germplasms, salinity tolerance, *Saltol 1* QTL, SSR markers

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Egg parasitoids of *Cnaphalocrocis medinalis* (Guenee): the first record of *Trichogrammatoidea bactrae* Nagaraja and *Trichogrammatoidea nana* Zehntner (Hymenoptera: Trichogrammatidae) in Sri Lanka

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The rice leaf folder, (RLF) *Cnaphalocrocis medinalis* (Lepidoptera: Pyralidae) is one of the pests attacking rice foliage. Defoliation damage caused by RLF larvae demands the implementation of control measures, usually the application of insecticides. This practice results the disturbances to the colonizing natural enemies in rice ecosystem. Hence, use of non-chemical strategies to manage RLF will enhance the colonization of natural enemy community in rice ecosystem. Therefore, biological control of RLF was suggested using egg parasitoids. As a first step of this endeavour, identification of naturally existing egg parasitoids is necessary. The objective of this study was to identify the egg parasitoids of RLF in rice ecosystem. The eggs of RLF were collected at weekly intervals over different durations in thirteen selected rice fields in Kandy, Anuradhapura and Kurunegala districts. The collected eggs were reared individually until emergence of parasitoid adult or the host larvae in clear plastic vials under laboratory conditions. The emerged parasitoid adults were dissected and slide mounted for microscopic examination to identify the species using taxonomic keys. The identities were verified by Natural History Museum, London. Two species of Trichogrammatidae parasitoids were found parasitizing the eggs of RLF: *Trichogrammatoidea bactrae* Nagaraja, *T. nana* Zehntner. Both species were not reported in Sri Lanka as per the Universal Chalcidoidea database, NHM, London. Characteristics of genitalia of both species well match with the original species description. *T. bactrae* was found in Megodakalugamuwa, Hindagala, Ihalawela, Penideniya, Ganegoda and Wathurakumbura (Kandy district) and Mahailluppallama (Anuradhapura District). *T. nana* was found only in Penideniya (Kandy district).

Key words: *Cnaphalocrocis medinalis*, *Trichogrammatoidea bactrae*, *Trichogrammatoidea nana*

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Salient characters of Weedy rice (O*ryza sativa* f. *spontanea)* populations in highly infested areas in Sri Lanka

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Weedy rice (WR) was first reported in 1990 and it is reported in varying population densities from all agro-ecological zones in Sri Lanka. The main problem faced by the famers and the agronomist is the identification of WR bio-types using agro-morphological characters varying with time. The WR population possibly possesses a number of derived characters and primitive characters. This study focuses on identification of primitive and derived characters observed in WR. The identification of salient trends of characters specialization in WR populations facilitates the understanding of the rate diversification of WR populations. Seeds of presumed WR bio-types were collected from five different locations in Kurunegala and Matara districts. Five replicates of each bio-type were planted in plastic pots with representative paddy soils from each location. Replicates were arranged in Complete Randomized Design (CRD). Agro-morphological characterization (using thirty six characters) of WR bio-types, Wild rice and cultivated rice varieties was made using a Standard Characterization Catalogue. The collected data were separated into nominal and scalar variables and the nominal data were used to construct Classification and Regression Trees using CART algorithm. The long-fully awned and absence of awn are apomorphic and short-fully awned and long-partly awned characters are pleisomorphic in WR biotype populations in Sri Lanka. These characters are hypothesized as derived from mixing of germplasm either of cultivated or wild rice varieties indicating possibilities of cross-pollination among wild, cultivated and weedy rice bio-types.

Key words: Agro-morphological, *Oryza sativa* f. *spontanea*, salient trends, Sri Lanka, Weedy rice

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Selection of suitable mango variety for fruit bar preparation

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Mango fruit is consumed in its many forms as fresh fruits and in preserved forms. Fruit bar is one of the preserved forms of fruits. Experiment was conducted to develop a fruit bar from mango varieties grown in Batticaloa District and to select a suitable mango variety for fruit bar preparation based on their chemical and organoleptic qualities. Mango fruit bars were developed from mango varieties vz: Willard, Karutha Kolumban, Vella Kolumban and Ambalavi. They were packed in polythene bags of 40µ. The fruit bars were stored at room temperature (30±2 °C), and the chemical and organoleptic properties were analyzed. The results of chemical analysis revealed that the titrable acidity of mango fruit bars prepared from different mango varieties ranged between 0.41 - 0.48% citric acid equivalents. The highest total sugar of 18.5% was obtained in fruit bar prepared from Willard variety and the lowest value of 15.4% in fruit bar prepared from Ambalavi variety. Total Soluble Solids Vitamin C, Titrable Acidity and Total Sugar contents of fruit bar prepared from Willard variety were 20%, 45 mg/100g, 0.42% and 18.5% respectively. There was no total plate count observed in the mango fruit bar during the preparation of fruit bars. Result of organoleptic evaluation showed that there were significant differences between fruit bars prepared from different mango varieties with respect of colour, flavour, texture and overall acceptability. Fruit bar developed from variety Willard had the highest mean value for overall acceptability and significantly differed from the fruit bars prepared from other varieties. Based on the quality assessments, fruit bar developed from variety Willard was found to be superior in quality.

Key words: Fruit bar, storage stability, sensory parameters.

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Heavy metal contamination in soils of a selected mapping unit in dry-zone of Sri Lanka

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Assessing the level of heavy metal pollution in soil is imperative to evaluate the potential risks to human health. This study aimed to assess the level of heavy metal pollution in three land uses of the Madawachchiya, Ranorawa, Elayapattuwa, Hurathgama and Nawagattegama soil association (all soils belongs to Alfisols order) using Geo accumulation Index (*Igeo*) and Pollution Load Index (*PLI*). Soil samples (0-30 cm) were collected from hundred and three geo-referenced locations representing lowland (38), upland (35) and non- agricultural (30) land uses. Samples were digested with 4M HNO_3 and analyzed for total Cu, Pb, Ni, Zn and Cd. Standard reference material (SRM-2586) was used for data validation and quality control. Geo accumulation Index (*Igeo*) and Pollution Load Index (*PLI*) were calculated for different land uses. Satisfactory recoveries were obtained with the SRM-2586 for Cd (87%) and Pb (92%) in 4M acid digestion. Microwave digested SRM sample showed the certified value of 2.7 ± 0.05 mg/kg of Cd and 425.92±39.8mg/kg of Pb ensuring the validity of the data generated. Concentrations of Cu, Pb, Ni, Zn and Cd were at the range of 1.56-33.51, 2.19-19.22, 1.58-32.17, 6.69-71.32 and 0.13-1.22 mg/Kg respectively. According to the *Igeo* classification, all the soils were classified into uncontaminated class with respect to Cu, Pb, Ni and Zn. *Igeo* index for Cd ranged from moderately to strong (Class 1-Class 4) for lowland and upland while for non-agricultural soils ranging from uncontaminated to moderate (Class 0-Class 3). The *PLI* values also confirmed that majority of the soils were in unpolluted condition in terms of overall heavy metal contamination.

Key words: Dry zone, Geo accumulation index, heavy metal pollution, Pollution Loading Index

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Identification of potential fertilizer management zones based on the spatial variability of surface soil pH in a vegetable field, Sri Lanka

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Site specific management of soil pH and nutrients is important for the effective use of soil inputs to obtain a higher yield at a minimum cost. This study was conducted to explore the variability of surface soil pH and subsequent delineation of potential management zones in an intensively cultivated vegetable field in the Wet Zone of Sri Lanka. The experimental site was located in the Doragala area which covers Kandy, Galigamuwa Lithosols complex. Thirty one topsoil (0–30cm) samples were taken by employing a stratified random sampling scheme. Soil pH was measured using 1:2.5 soil to 1M KCl. Descriptive statistics of the soil pH were calculated using SPSS 18 statistical software. The experimental variogram for soil pH was calculated and a theoretical model was fitted using variowin software. A map of soil pH was developed using the ordinary kriging interpolation technique. The fuzzy k-means technique was used to establish the management zones. The soil pH showed a normal distribution with a skewness of 0.231. Soil pH of the field was in the range of 5.80 to 7.05, with a mean value of 6.41.The spherical model fitted to the experimental variogram of soil pH showed a sill variance of 0.11 and a range value of 23.3 m. The ordinary kriged map showed a strong spatial variation of the soil pH within the field. The fuzzyk-means classification procedure revealed that the field can be divided into two potential management zones. Moreover, the average soil pH values were significantly different across these potential management zones (pH=6.1 and 6.7, respectively). This study revealed that the within-field variability of soil pH in the selected field is significant and this variability is sufficiently structured to identify two potential management zones to support nutrient management. However, further studies are needed to assess the production and economic benefits.

Key words: Liming, management zones, spatial variability, variogram

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Present status of pesticides usage and level of awareness among farmers in Jaffna peninsula

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Pest control is mostly dependent on the use of synthetic pesticides in Jaffna, However the pesticides are used inappropriately in intensive cultivation of crops. Due to the increase of pesticide hazards, an attempt was made to understand the present status of the pesticide usage in the fields in eight selected Divisional Secretariats of Jaffna district. The pesticide usage was assessed through questionnaires from randomly selected farmers. Our study indicates that, 42.9% of farmers were adhered to recommended levels whereas 9% used extremely high doses and 18% used slightly higher doses than recommended levels. 29.9% of farmers used levels lower than the recommended levels. It was recorded that 85.6% of farmers mixed different pesticides without recommendation before spraying. Agro chemicals used by the farmers can be categorized based on the labels; yellow label (30.3%), blue label (5.9%) and green label (60.3%). The chemicals which are not recommended for pests or diseases used can be categorized based on their toxicity as represented by the labels; yellow label (73.1%), blue label (14.1%) and green label (12.5%). Agro chemicals used experience by the farmers for more than 15 years was 31.4% and less than 5 years was 36.4%. Percentage of farmers not wearing protective cloths like mask, gloves and not taking bath after spray was 89.1%, 79.7% and 5.1%, respectively. The results of this study revealed that farmers are abruptly using the pesticides to control the pests. Therefore, it is recommended to provide awareness on the hazardous effects of pesticides among the farming community.

Key words: Agro chemicals, Jaffna, pesticides, toxicity

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Phytochemical screening and bacteriological assay of tea samples from upcountry and low country Sri Lanka

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Tea is one of the most important industries which significantly contribute to the gross national product (GNP) of Sri Lanka. In order to investigate the health effects of drinking of Sri Lankan black tea samples, antimicrobial activity of extracts of BOP (upcountry), BOP (lowcountry), BOPF (upcountry), BOPI (low-country), Dust (upcountry), and Orange Pekoe I (lowcountry) was screened against Gram (+) Methicillin resistant *Staphylococcus aureus* (MRSA) and Gram (−) *Escherichia coli*. Out of the tea samples tested all black tea hot water infusions showed antibacterial activity against MRSA on agar plates incorporated with different dilutions. However, no antibacterial activity was observed against *E. coli*. Comparatively, upcountry tea samples had a significantly higher inhibitory activity against MRSA than low country tea. Antibacterial activity of tea samples against MRSA was further carried out using sequential Soxhlet extracts of pet-ether, chloroform, ethyl acetate and ethanol of tea samples in order to investigate which solvent fraction has highest antibacterial activity. Ethanol and ethyl acetate extracts of the tea samples had higher antibacterial activity than the other extracts and ethyl acetate extracts showed highest inhibitory activity against MRSA (at 0.05 probability level). Analysis of phyto-chemicals of Soxhlet extracts of tea showed that all tea samples were found to be the same. Aalkaloids, steroids, sterols and triterpenoids, cardiac glycosides, flavonoids and polyphenols were present in all tea samples tested, regardless of the geographical region. From the fractions separated, flavonoids showed considerable inhibitory activity compared to alkaloids and cardiac glycosides.

Key words**:** antibacterial activity, *E. coli*, MRSA, phytochemicals, Soxhlet extracts

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Preliminary evidence of Bermuda grass white leaf (BGWL) phytoplasma associated with rice yellow dwarf disease (RYD) in Sri Lanka

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Phytoplasmas are cell-wall-less bacteria and known to cause disease in hundreds of plant species worldwide. Phytoplasma diseases have significant impact on yields of many important crops including rice (*Oryza sativa*). Rice yellow dwarf disease (RYD) continues to be a problem for rice farmers in many regions of Asia. Infected rice turns pale yellow and gradually starts to decay and ultimately shows stunted growth and fails to produce grain. RYD phytoplasma has been classified in RYD 16S-group XI and its closest known relatives are the phytoplasmas associated with sugarcane white leaf (SCWL), and sugarcane grassy shoot (SCGS) found in sugarcane. In addition to RYD phytoplasma, several phytoplasmas infect gramineous plants, including rice orange leaf (ROL), Bermuda grass white leaf (BGWL), and *Brachiaria* grass white leaf (BraWL) phytoplasmas. In Sri Lanka, yellowing and stunting of rice plants similar to the RYD has been reported and the causal agent is not identified. Symptoms similar to RYD rice plants were collected from Monaragala and Weligama areas and positive for phytoplasma when subjected to nested PCR with phytoplasma universal primers. The amplicons were sequenced and BLAST search showed that the sequences had >98% similarity with Bermuda grass white leaf (BGWL) group (16SrXIV). Phylogenetic analysis based on 16S rRNA gene revealed the clustering with BGWL groups. Further research is being carried out in order to consolidate this finding with more samples and additional genes such as *secA* for better resolution of phytoplasma grouping.

Key words: Phytoplasma, Rice, SCWL, BGWL, RYD

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Induced colonization of GFP- labeled *Azorhizobium caulinodans* ORS 571 in rice roots

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Rice, being the most highly consumed cereal crop in Sri Lanka demand a very high input of nitrogen fertilizer for cultivation. Use of nitrogen fertilizer over a long period is known to cause many environmental and socio-economic problems. In the search of an alternative for nitrogen fertilizer, Biological Nitrogen Fixation (BNF) is an excellent alternative. Successful colonization of rice roots by a nitrogen-fixing bacterium is a prerequisite for producing a nitrogen fixing rice plant. This study aims at inducing colonization of *Azorhizobium caulinodans* ORS 571 in the roots of rice variety BG 359 (i.e. cultivar popular in Sri Lanka) and determining the optimum conditions for maximum efficiency of colonization, in terms of inoculum volume, frequency of inoculation, best time interval for the detection of the bacterium inside the rice plant in the presence of a signalling molecule Naringenin. The bacterium *A. caulinodans*, being a free-living nitrogen fixer, and having the ability to tolerate oxygen 3% v/v is advantageous over other nitrogen fixers in non-symbiotic nitrogen fixation. The bacterium was labelled with a green fluorescent protein marker (GFP) for reliable and accurate detection *in vivo*. GFP- labelling was carried out by inserting the *gfp* gene containing plasmid pBBR5-hem-gfp5-S65T into *Azorhizobium caulinodans* ORS 571, with the help of a helper plasmid (pRK2013) by tri parental mating. The degree of colonization was measured through fluorescence of GFP by computer software (ZEN 2012). The colonization increased up to the 25^{th} day and then decreased giving very low intensity measurements. It was revealed that 5ml (10^8 cells/ ml) of the culture added twice a week for 15 days results in best conditions for colonization by statistical analysis. Optimum conditions can be used for future experiments of nitrogen fixation in rice.

Key words: *Azorhizobium caulinodans* ORS 571, BNF, detection *in vivo*, GFP

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Heavy metal pollution effects on photosynthetic characteristics of *Fucus vesiculosus* and *Ulva lactuca*

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Heavy metals caused environmental pollution is a world-wide problem in estuarine, coastal and marine waters. Metal pollution affects different organisms in different ways and the degree of the impact is site-specific. In order to assess the metal pollution impact, it is necessary to study the respective chemical and the species concerned. In the present study two species of marine macro algae (*Fucus vesiculosus* and *Ulva lactuca*) and three kinds of heavy metals (Cu, Cd and Pb) were selected. Hence, the aim of the study was to determine the effects of said metals exposure on tissue accumulation, and photosynthetic characteristics (pigmentation and primary productivity) of macro algae under controlled laboratory experiments. Algae were collected from a reference location, Wemeldinge in the Eastern Scheldet Estuary in Netherlands during March 2009. Accumulation of metals in plant tissues was studied exposing two macro algae to three different concentration series (0.00, 0.01, 0.1, 1.0 and 10.0 μM) of Cu, Cd and Pb for 48, 96 and 504 hours respectively. Metal concentrations were determined using Inductively Coupled Plasma Mass Spectrometer (ICP-MS). Productivity of algae was measured using Winkler method (for measuring the amount of oxygen) and the results were expressed as carbon equivalent. Pigment profiles of two species were analyzed by spectral absorbance over 250 -1100 nm range. The results reveal that the metal accumulation in tissues significantly increases with increasing exposure metal concentration whereas, pigmentation, and photosynthetic productivity decrease with increasing metal concentration. Hence, macro algae can be used as indicator organism to determine metal pollution in coastal waters.

Key words: Bio-indicator, heavy metal bio-accumulation, marine macro algae, pigmentation, primary productivity

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Physicochemical and microbiological quality of selected non-carbonated bottled drinking water sold in Southern province of Sri Lanka

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Bottled drinking water from southern province of Sri Lanka, representing the three districts, was characterized by means of their physicochemical and microbiological composition. Six different commercial brands of bottled water samples were collected on regional and popularity basis. In order to assess the effect of different storage conditions (sun exposure, refrigeration and normal, and storage time), different commercial bottled water brands were analyzed to determine the quality parameters described below. These parameters were compared against International (WHO - World Health Organisation) and National (SLS – Sri Lanka Standards) standards. The microbiological parameters (total coliform) and seven out of eight physicochemical parameters such as turbidity, electrical conductivity, hardness etc. of all brands of bottled water were within the permissible range for local and international standards, except pH as it was determined to be lower than the accepted standard. This study also revealed that there is a considerable amount of variation in the quality parameters of bottled water, though within the accepted range, when the storage conditions and storage times are considered, for different commercial brands of water bottles.

Key words: Bottled drinking water, physicochemical and microbiological composition, WHO standards & SLS standards

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Inhibition effect of jackfruit (*Artocapus heterophyllus*) leave extract on the corrosion of mild steel in 1 M HCl medium

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Effect of water extract of ripe jackfruit leaves as a green corrosion inhibitor for mild steel and the effect of temperature on inhibition efficiency of the extract in 1M HCl medium were studied using weight loss measurements. The behavior of the inhibitor was investigated using potentiodynamic polarization techniques. The inhibition efficiency of the extract increased with increasing concentration of the extract and decreased with increase in temperature. The adsorption of the inhibitor, water extract of ripe jackfruit leaves on mild steel surface obeys the Langmuir adsorption behavior, giving evidence that adsorption mainly takes place by chemisorption and it was verified from the estimated thermodynamic parameters of the process, equilibrium constant, K_{ads} and ΔG^0_{ads}. Investigation on effect of temperature on adsorption behavior discovered that the chemisorption of water extract of ripe Jackfruit leaves on mild steel surface is not activated. Potentiodynamic polarization studies revealed that the extract behaved as a mixed type inhibitor and the results are in good agreement with the results of weight loss measurements.

Key words: Adsorption, corrosion inhibitor, jackfruit leaf extract, Langmuir isotherm

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Phenolic content and antioxidant activities of millet grains as affected by solvents and extraction methods

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Phenolic compounds ubiquitously found in plants act as effective natural antioxidants. Millets are underutilized cereals even in millet producing countries but are good source of phenolics. In the present study, the effect of extraction solvent and conditions on the total phenolic content (TPC), total flavonoid content (TFC), and proanthocyanidins contents (PC), and antioxidant activities of millet grains were investigated. Three solvent systems, namely 70% acetone, 80% methanol, and 80% methanol with 1% HCl were used. The extraction method used was refluxing at 60^0C, followed by shaking in a water bath at 50^0C and room temperature. The TPC measured using Folin Ciocalteu's reagent of finger and foxtail millets differed from 34 to 111 and 4 to 14 µmol ferulic acid equivalents (FAE)/g defatted meal, respectively. The TFC and PC contents of finger and foxtail millets were in the range of 0.3–12.0 and 0.1–5.0 µmol of catechin equivalents (CAE)/g of defatted meal, respectively. Aqueous methanol with HCl was found to be the most effective solvent system among others used in this study, and gave the highest TPC for finger and foxtail millet grains under refluxing extraction. However, antioxidant activities, as determined by reducing power (RP), trolox equivalent antioxidant capacity (TEAC) and oxidation inhibition of β carotene in the β carotene-linoleate system differed depending on the extraction techniques used. In conclusion, the results of this study demonstrated that the solvent system as well as the extraction method influenced the extraction efficacy of phenolic compounds in millet grains and their antioxidant activities.

Key words: Finger millet, Foxtail millet, Total phenolics, TEAC

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Qualitative and quantitative investigation of phytochemicals present in the leaves of Thebu, *Costus speciosus*

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This study investigated the qualitative and quantitative analysis of the major bioactive constituents in the leaves of Thebu, *Costus speciosus*, which belongs to the family Costaceae. Phytochemical investigations were carried out using standard procedure described in the literature for the powdered plant material or methanolic extract or other solvent extracts of the leaves depending on the requirement of the procedure. The qualitative analyses revealed that the leaves of *C. speciosus* contain alkaloids, flavanoids, saponins, tannin, terpenes, steroids, poly phenolic compounds and carbohydrates. The quantitative analysis indicated that the leaves contain 0.33% of alkaloids, 0.56% of tannin, 0.41% of flavanoids, 0.33% of saponins and 1.1% of polyphenolic compounds.

Key words: *Costus speciosus*, Phytochemicals, qualitative, quantitative analysis

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Structural model of tRNA(guanine-N1)-methyltransferase by a computational method

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In this research, we have modeled a three-dimensional structure of tRNA(guanine-N1-)-methyltransferase which consists of 232 amino acids. This enzyme belongs to the family of transferases that catalyzes the reaction of methylating guanosine (G) at position 37 of tRNA to N1-methylguanine (1-methylguanosine (m1G)) via *S-adenosyl-L-methionine*. The presence of m1G improves the cellular growth rate and polypeptide step-time and also prevents the tRNA from shifting the reading frame. Computer software (O, SOD, and MOLEMAN) from Uppsala Software Factory (USF) has been used as main tools for modeling, and NCBI, PDB, BLAST and CLUSTALW databases were used for sequence comparison and alignment. The model was evaluated by PROCHECK. The crystal structure of a putative tRNA (guanine-7)-methyltransferase (PDB ID: 3ky7) which was shown 53% sequence identity with the target protein was used as the template. The region 229-232 in the C-terminus in the target protein was not modeled. The gap between residues 41-42 found in a loop region was inserted using O program. The other gap found between residues 68-69 in a helical region was not inserted. This model consists of two domains. The domain I contains five parallel β-strands forming a β-sheet and five α-helices. The α-helices are wrapped around both sides of the beta sheet similar to the other methyltransferases. The domain II contains two α-helices. The PROCHECK analysis showed only Asn44 and Trp71 found in the disallowed region of the Ramachandran plot. Therefore, it suggests that the model is of good quality. For the best of our knowledge, this is the first structural model of tRNA (guanine-N1-)-methyltransferase and will be much more useful for further studies of this protein.

Key words: 3D-structural model, homology modelling, methyltransferase, tRNA (guanine-N1)-methyltransferase

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Synthesis and characterization of bimetallic nanocomposites for conductive coatings

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Metal nanoparticles possess very useful catalytic, magnetic, electronic, optical etc. properties. Investigations have indicated when a metal was associated with another metal in bimetallic or alloy form, the properties of resulting material could be enhanced with respect to those of the pure metals. For example, nickel- based bimetallic particles containing copper exhibit better catalytic activity and selectivity than monometallic nickel. In addition, bimetallic nanoparticles possess very useful multi-functionalities. Nickel core-Silver shell composite nanoparticles possess not only magnetic properties of nickel but also antibacterial properties of silver. Because of many useful novel applications, synthesis of bimetallic nanoparticles has been gaining greater attention. In this study, polyol method has been used to synthesize copper core-silver shell composite nanoparticles. Microwave irradiation was used for heating. The ultimate goal is to incorporate these core-shell bimetallic composite into acrylic-based environment friendly emulsion for shielding from electro magnetic radiation (EMR). Application of this type of conductive coating on touch panels, cell phones etc**.** makes them function without any interference from EMR. Synthesis, characterization and applications of bimetallic Cu core-Ag shell are discussed.

Key words: Conductive, Core - shell nanocomposites, EMR microwave, emulsion

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Mechanochemical treatment for the detoxification of organic pollutants in agricultural wastes

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A mechanochemical treatment was used for the dechlorination of several organic pollutants such as chlorobenzene, dichloroaniline, etc., generated from agricultural wastes. The chlorinated compounds were mixed with two metal oxide catalysts, CaO and Fe_2O_3, and subjected to grinding for 45 minutes. The organic products were extracted and characterized by chromatographic methods including Thin Layer Chromatography and Gas Chromatography. Dehalogenation was observed in dichloroaniline, chlorobenzene and others. The dehalogenation efficiency was dependent on the ratio of CaO and Fe_2O_3. When the ratio of CaO and Fe_2O_3 was 6:4 the maximum efficiency of 70% dehalogenation of chlorobenzene was obtained in 45 minutes of grinding.

Key words: Dehalogenation, mechanochemical

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Isolation of natural pigments with potential photosensitizing property

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Potential photosensitizing property of three new natural plant pigment-extracts and variation of their UV-vis spectra with pH have been investigated. The pigment-extracts were obtained from fruits of *Basella alba* (spinach), *Brassica oleracea* (red cabbage) and sawdust of *Artocarpus heterophyllus* (Jack tree). The extraction efficiency of the pigments of fruit of spinach into water, ethanol and methanol was also studied at three different temperatures. The best extraction efficiency was achieved in water at low temperature, however, the stability of the spinach pigments in water was very poor. Therefore, pigment mixture of fruits of spinach extracted into 80% methanol, which was quite stable at room temperature was used for further studies. The colour of this pigment extracts remained unchanged under acidic conditions. The variation of λ_{max} of the UV-vis absorption spectrum of the pigment extract with pH was studied. A hypsochromic shift of the spectrum was seen, indicating a decrease in conjugation with increasing pH. Photosensitizing nature of this pigment extract was studied by preparing a Dye Sensitized Solar Cell (DSSC) and found to be effective in photosensitization. Pigments of red cabbage were extracted into water and the variation of λ_{max} of the UV-vis spectrum of this pigment-extract with pH was also studied. It showed a bathochromic shift of its λ_{max} with increasing pH. This pigment extract also showed photosensitizing property when used in DSSC. The pigments of sawdust of Jack tree were extracted into dilute NaOH and the variation of UV-vis spectra of this pigment extract with pH was also studied. This pigment extract did not show any photosensitizing properties when used in DSSC. Pigment extract of this species was found to be highly fluorescent and could well be the reason for poor sensitizing property in solar cell.

Key words: DSSC Pigments, fluorescence, photocurrent

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Development and optimization of novel liquefaction modified cornstarch wood adhesives

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The development and optimization of an environmental friendly wood adhesive system for plywood from abundant and renewable cornstarch and *pine* bark are presented in this study. Cornstarch was chemically modified by two methods viz., oxidation with 3% (w/w) hydrogen peroxide and also chemically fortified with glycerol and/or oxalic acid in the range (10-50 %) (w/w). *Pine* bark is a waste product also used to modify cornstarch hence the optimized conditions for the preparation of cornstarch-liquefied *pinus* bark adhesives were determined. *Pine* bark in phenol in the weight ratio of (2:1 = phenol: bark) with the catalyst of *para* toluene sulphonic acid yielded 65% (w/w) liquefaction product and oxidized cornstarch was blended at different weight ratios to investigate the improvement of thermoplastic nature. The influence of oxidation and blending of cornstarch was evaluated and the optimum parameters studied are the percentage of cornstarch, amount of liquefied bark in the adhesive system and pressing time of the plywood specimens. Shear strength of different concentrations of modified cornstarch and unmodified cornstarch were compared. It was found that cornstarch at 65 % weight ratio with that of 10% (w/w) liquefied bark addition has improved the mechanical properties of both oxidized and native cornstarch. The optimum time at 120^{o}C temperature hot pressing was 5 min. The results indicated that the thermo plasticized corn starch specimens containing a mixed plasticizer showed the highest values of shear strength, because this mixed plasticizer system could form stronger hydrogen bonds with wood and cornstarch molecules.

Key words: liquefied bark, oxidized cornstarch, plywood, shear strength

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Development of novel catalysts for fischer-tropsch synthesis

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Binuclear metal complexes of copperand cobaltwere supported as sub monolayer, monolayer and multilayer films on silica (Cab-O-Sil). The supported metal complexes were characterized by elemental analyses, DRIFTS, XRD and TGA. Elemental analysis results confirmed that the carbon/metal ratio of the supported complexes was the same as the parent metal complexes. Upon adsorption, certain IR peaks of the parent metal complexes were shifted indicating the strong interaction between the metal complex and the silica support. Metal complex loadings were monitored by UV-vis spectroscopy and confirmed by TGA and elemental analysis. After calcination, monolayer and multilayer films were used as catalysts for the Fischer-Tropsch (FT) reaction (conversion of CO and H_2 to gasoline) at moderate temperatures and high pressures. Total CO conversions and gasoline yields were studied as a function of time of syngas on stream (15-75 h), temperature (310, 320 and 350˚C), and total pressure (750 and 910 psi). The product distribution of multilayer catalyst differed with extended reaction time on stream, temperature and pressure. C_{4+} hydrocarbon selectivity significantly increased with a 70 h reaction time. This suggests that extended reaction times give enough time for short chain hydrocarbons to grow into long chain hydrocarbons. After a 70 h reaction time, CO_2 selectivity decreased dramatically. An increase in temperature also increased the C_{4+} hydrocarbon selectivity. 910 psi pressure reaction conditions also shifted the FT reaction to the product side. The C_{4+} product selectivity was improved by the 910 psi pressure reaction conditions.

Key words: DRIFTS, Fischer-Tropsch synthesis, monolayer, Silica-supported catalysts

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HEC-HMS model for runoff simulation from Tittawella tank catchment

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The paper describes a case study of event based and continuous hydrologic modeling of inflows to the Tittawella tank in Kurunegala using the Hydrologic Engineering Center – Hydrologic Modeling System (HEC–HMS). A high rainfall event in Oct-Nov 1995 was used for calibration of model parameters and high rainfall events in Oct 1996 and May 1995 were used for validation of the event based model. The calibrated model parameters were used in the continuous hydrologic model. Time series data of Sep-Nov 1995 were used for calibration of the continuous model, while three months, one year and two year time series data were used for validation of continuous simulations. The initial and constant infiltration loss method was used to account infiltration loss in event based modeling and 5–layer soil moisture accounting loss method was utilized in continuous modeling. Clark unit hydrograph method and recession base flow method were used to simulate direct runoff and base flow, respectively. The validation results reveal the capability of HEC–HMS to reproduce stream flows in the catchment to a high accuracy with averaged computed Nash Sutcliffe efficiencies of 0.89 for event based simulations and 0.76 for continuous simulations. The calibrated model can be used to water management studies in Deduru Oya development project.

Key words: Continuous, event based, HEC – HMS, modeling, Deduru Oya

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Effects of $CaCl_2$ solution on physical, index properties of liner materials

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The main task of clay liners in landfills is to mitigate the migration of pollutants to the groundwater sources. Leachate includes different types of inorganic and organic compounds which affect physical, index properties of clay liners that can affect the long-term performance of these clay liners as a barrier. The $CaCl_2$ solution exerts the strongest effect on clay liner materials than any other chemicals in leachate. The objective of this study was to evaluate the effect of inorganic salt $CaCl_2$ on some physical, index properties of expansive soil (Soil M) obtained from Moragahakanda area. Also, the effect of $CaCl_2$ on Soil M amended by 5% (Soil M+5%) and 10% (Soil M+10%) bentonite, on selected physical, index properties was investigated. The effect on physical, index properties was investigated by carrying out Atterberg Limits Tests, Modified Free Swell Index, Specific Gravity, Shrinkage Limit and Mechanical Analysis before and after samples consolidated under pressures of 50, 100, and 200 kPa were subjected to the permeation of 1M $CaCl_2$ solution under gradually increasing constant head of 50, 100 and 150 kPa, up to replacement of their void volumes by as much as 20 times to simulate long-term contact. After long-term contact of consolidated soil samples with $CaCl_2$ solution, the Liquid Limit value of Soil M, Soil M+5% and Soil M+10% was found to be decreased by 22%, 19% and 31% respectively, but only the Plastic - value of Soil M+10% was increased by 12% points. Although LL and PI values were reduced after contact with $CaCl_2$ solution, the soil classification of Soil M (CH) and Soil M+5% (CH) did not change. However, Soil M+10% was reclassified from Clay of Very High Plasticity (CV) to Clay of High Plasticity (CH). These test results indicated that $CaCl_2$ salt affected the plasticity of all candidate soils even up to the extent of changing the soil classification for the expansive soil amended by 10% bentonite.

Key words: Bentonite, $CaCl_2$ solution, clay liners, expansive soil, index properties, physical

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Controlled growth of ZnO/SnO_2 mixed nanowires by carbon assisted thermal evaporation process

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This work reports the controlled growth of ZnO/SnO_2 mixed nanowires, fabricated by the bottom up process of carbon assisted thermal evaporation method, through vapor-liquid-solid (VLS) mechanism. In this study, SnO_2, ZnO and activated carbon powders are used to grow ZnO/SnO_2 mixed nanowires with the help of a gold catalyst on alumina substrate. Tin, zinc, and gold eutectic compounds promote a nucleation site for the deposition of ZnO/SnO_2 mixed nanowires synthesized at 900°C. The crystalline structures of ZnO/SnO_2 nanowires are analyzed by X-ray diffraction (XRD). The morphological characterization of fabricated products is performed by field-emission scanning electron microscopy (FESEM). A sharp peak of XRD patterns exhibits the high crystallinity of the ZnO/SnO_2 mixed nanowires. FESEM images show that the length of nanowires increased from 2 μm to 80 μm with the increase of growth time from 30 min to 120 min. These mixed nanowires could find potential applications in chemical gas sensors and optoelectronic devices.

Key words: Carbon assisted thermal evaporation method, ZnO/SnO_2 nanowires, vapor-liquid-solid mechanism

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Production of high quality iron ore briquettes using coconut-shell charcoal and 'aruwakkalu lime'

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The aim of this project was to make iron ore briquettes of sufficient handling strength and quality to be used in blast furnaces, in particular, to experiment a cheap iron ore agglomeration method which would yield briquettes with properties good enough to be reduced under furnace conditions. Developing a feasible method for iron ore briquette agglomeration was the first half of the project, while finding the ideal briquette compositions was the aim of the project afterwards. The expected outcome of this project was to prove that it was possible to make high quality iron ore briquettes from locally available raw materials such as Dela, Aruwakkalu lime and coconut shell charcoal. The expectations to produce an iron ore briquette composition of ideal green strength and firing properties were fulfilled successfully.

Key words: Iron ore agglomeration method, iron ore briquettes

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Solar heat gain in residential buildings through roof

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As Sri Lanka is a tropical country, it is important to understand the science of solar heat transfer into buildings through roofs, walls and windows. Present study was aimed at studying solar heat transfer into residential buildings through roof. Study was carried out using a test cell of 8'X8'X8' in size with a selected roof design with four pitches. Surface temperatures of all four pitch surfaces and ceiling were measured every 5 minutes using Platinum resistant thermal sensors. In addition, attic, inside cell and ambient temperatures were recorded at the same time intervals. Direct solar insolation was measured using a pyranometer and for the measurement of indirect insolation, same instrument was covered using a strip of paper in order to obstruct direct component. Heat flux received by each pitch was calculated using Liu – Jordon formula. Heat flow from ambient to room was calculated using Sol – Air Temperature method. Throughout the study, it was assumed that heat entering through roof equals the heat passing through ceiling. Also this amount of heat is equal to the heat exchange between the room and surrounding. It was observed that heat gain through roof is dominant when compared with walls and window. Maximum room temperature was at a maximum few hours after noon. Also direction of roof inclination has significant effect on heat transfer. Assumption that was made equalizing heat flow through roof and entire roof structure is reasonable for this type of calculations.

Key words: Solar heat transfer, surface temperature

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A low cost automated device for releasing a certain mass of small seeds or powder materials

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A simple automated device has been designed and constructed in order to release a certain mass of small seeds or powdered materials. The device uses a screwed axel rotating inside U shaped tube, which is fixed to the bottom of the container to push the material cut of the container. This preliminary study indicates that the device releases small seeds or powder materials with an adjustable and constant rate with a higher accuracy. The weight of releasing seeds or powder materials could be adjusted to any pre determined value from 0 g to 5 kg (range of the load cell). As an example, it could release 50 g of chili powder in about 50 s with an accuracy of ±1 g. The efficiency of the measuring mechanism could be increased by increasing the rotational speed of the screw and vice versa. The accuracy of the measuring mechanism could be increased by decreasing the pitch and depth of the screw. The space between the screw and U shaped tube is another key factor, which determines the efficiency and accuracy of the device. The constructed device (screw dimensions: pitch = 8 mm, depth = 2 mm) could be used for measuring any dry material with particle size less than 3 mm. This could be modified and used for many applications ranging from small-scale shops to large-scale industries. The accuracy and efficiency could be improved further. The main advantage is that the device could be easily manufactured locally at a low cost and it could be used in small industries which produce packets of dry seeds or powder materials.

Key words: Coaxially, depth, efficiency accuracy, pitch

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Preliminary results on the preparation of CdS thin films using electro-deposition technique for applications in CdS/CdTe solar cells

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Cadmium Sulphide (CdS) thin films were electrodeposited onto Indium Tin Oxide (ITO) coated glass substrates from an aqueous solution containing 0.3M $CdCl_2$ and 0.03M $Na_2S_2O_3$. Properties of CdS thin films prepared at different deposition voltages, time periods and temperatures and different annealing temperatures were investigated using current-voltage (I-V) characteristic plots. Best quality CdS layers were found to form under deposition conditions of -1.13V for a period of 45 minutes in a solution at a temperature of 46° C with 1.4pH. The best film was formed after annealing at 400° C for a period of 20 min. The same procedure was followed by taking Thiourea [$SC(NH_2)_2$] as the Sulphur (S) source. The properties of CdS thin films prepared by changing electrode configuration and cleaning procedure using above two electrolytes were compared using current-voltage characteristic plots. A significant improvement of current was found of samples prepared using later electrolyte compared that with the former electrolyte. Further, analysis of XRD spectra showed hexagonal crystal structure of CdS films, confirming the quality of films prepared by the later method.

Key words: Cadmium Sulphide, Cadmium Telluride, electro-deposition, electrolyte, XRD

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Characterization of Cu_2O layers prepared by photo-electrochemical and electro-deposition methods and their applications in electrochemical solar cells

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Cuprous oxide (n-Cu_2O) and CuSCN (p-type) layers were deposited on copper substrates using photo-electrochemical method to form p-n junction solar cells. Further, n-Cu_2O layers were deposited on Indium Tin Oxide (ITO) substrates using electro-deposition method. The current-voltage (I-V) characteristics of the above layers were measured and I-V characteristics of n-Cu_2O layers on copper (Cu) and ITO substrates deposited using above two methods were compared. It was found that when Cu_2O layers deposited on ITO substrate by electro-deposition technique produced higher cell performance compared to the n-Cu_2O layers deposited on Cu substrate by photo-electrochemical technique.

Key words: Conductive glass plates, Cu_2O (Cuprous Oxide), electrochemical deposition, photo-electrochemical, solar cell

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Solid state photovoltaic cell made from n-Cu_2O thin films and activated carbon upper electrode

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A thin film solar cell was prepared by using n-type Cu_2O layers and coconut shell activated carbon (CAC). Cu_2O layers were prepared by boiling the copper plates in a $CuSO_4$ (10^{-3}M) solution for a certain time. The band gap of n-Cu_2O was ≈ 1.9 eV. The coconut shell charcoal was activated by the steam method and it served as an upper electrode of this particular photoelectrode. Diffuse reflectance spectra, photocurrent action spectra, V-I characteristics and stability curves were used to discuss the characteristics of this solid state thin film solar cell. The power conversion efficiency was largely influenced by the surface area of CAC. The maximum power efficiency of 2.5% was observed when the surface area of CAC powder was 1157.2 m^2g^{-1}, and that was used for constructing of the upper electrode of this thin film solar cell.

Key words: Activated carbon, CAC, n-Cu_2O, thin film solar cell

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Measurement of the transverse momentum distribution of Z bosons decaying to dimuons in pp collisions at center-of-mass energy of 8 TeV

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The measurement of the transverse momentum distribution of the dimuon system, produced in the Drell–Yan process is reported for the Z boson mass range of 60 to 120 GeV/c^2. The results are obtained using a data sample of proton-proton collisions at a center-of-mass energy of 8 TeV, collected by the CMS experiment at the Large Hadron Collider, corresponding to an integrated luminosity of 18.4pb^{-1}. The measured transverse momentum distribution is compared to the most commonly used event generators in the CMS experiment such as Powheg+Pythia, MadGraph. Furthermore, the transverse momentum distribution is compared with several tunes of Pythia for the underlying event in the low transverse momentum regime and the most accurate theoretical calculation at Next-to-Next-to Leading Order (NNLO) from FEWZ package is used in the high transverse momentum regime. It is concluded that Pythia generator with Z2star and Madgraph describe the data well at low q_T and high q_T regimes, respectively. An overall agreement with the predictions of the standard model is observed.

Key words: CMS, dimuon, LHC, physics, transverse momentum

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Optimizing growth process of CdS semiconductor thin films for efficiency enhancement in CdS/CdTe solar cells

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Thin film CdS/CdTe solar cells have emerged as a cost effective and high efficiency alternative to expensive silicon solar cells. Optimizing the growth process of CdS films is important in order to further enhance the efficiency of these solar cells. Transparent and homogenous cadmium sulfide (CdS) thin films were deposited by chemical bath deposition (CBD) technique on microscopic glass substrates by varying the deposition time from 20 to 60 min in a chemical bath containing cadmium chloride, ammonium chloride, ammonium hydroxide and thiourea and maintained at 65^0C. The effect of the film thickness on optical energy band gap was studied by measuring the absorbance from 190 nm to 1100 nm using a UV VIS- 2450 (SHIMADZU) spectrophotometer. It was observed that the optical energy band gap values of CdS thin films decrease with increasing the thickness (deposition time) of the films and approach the value of 2.42 eV for the films deposited for 60 min.

Key words: CBD method, CdS thin films, Optical energy band gap

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Inverted Poly(3-hexylthiophene-2,5-diyl)(P3HT):[6,6]-Phenyl C61 butyric acid methyl ester (PCBM) bulk heterojunction solar cells with cadmium sulfide (CdS) as the hole blocking layer

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P3HT:PCBM bulk heterojunction solar cells with poly 3,4-ethylenedioxythiophene:poly styrenesulfonate (PEDOT: PSS) as Hole Blocking Layer (HBL) has become increasingly feasible with large-area of donor–acceptor interface for efficient light-induced charge separation. Few metal oxides have also been utilized for P3HT: PCBM based solar cells as HBL which blocks the back electron leakage and increasing the charge collection before recombining. Although PEDOT: PSS has been heavily studied in these types of solar cells, it has been identified as a source for degrading the active layer due to its hydrophobic nature. In this study, inverted P3HT: PCBM solar cells were fabricated by using either of CdS and TiO_2 thin films as HBL, and the effects of CdS layer thickness on the device performance were investigated. The device with thin CdS layer offered short circuit (J_{SC}) over 7.5 mA/cm^{2}with an open circuit voltage (V_{OC}) of 0.57 V which provides overall power conversion efficiency of over 2 % under AM 1.5 illumination (100 mW/cm^2) conditions, which is over 100 % higher than that of Titanium dioxide thin film as the hole blocking layer. The major contribution is 75 % improvement in the V_{OC}, due to the lower work function of CdS. Even though there was a small improvement in the V_{OC} with the thickness of CdS thin film, the conversion efficiency is decreased due to reduced J_{SC} as per the strong absorption of CdS in the UV region verified by the optical absorption spectra.

Key words: CdS, electron selective layer, P3HT:PCBM, thin film, polymer

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Polymethylmethacrylate based gel polymer electrolyte: An impedance spectroscopy study

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Gel polymer electrolytes have been recognized as a suitable class of electrolytes in various electrochemical applications such as rechargeable cells, super capacitors and electrochromic devices. It is due to the fact that they show appreciable ionic conductivities while possessing good mechanical stabilities which are absent with many other electrolytes. To be suitable for applications, any electrolyte should have a good stability with electrodes as well. In this work, the characteristics namely conductivity and stability have been studied for a gel polymer electrolyte based on the polymer, Polymethylmethacrylate (PMMA) using Impedance Spectroscopy technique. The composition of the sample was 22.5% PMMA / 30% EC / 30% PC / 17.5% Cu $(CF_3SO_3)_2$ (by weight). Impedance measurements were carried out in the frequency range, 37 kHz – 0.01 Hz from room temperature to 60^0C using two stainless steel electrodes. Impedance plots were consisted with a semicircle and a spike at medium frequency and low frequency regions. The conductivity was found to be in the order of 10^{-3} S cm^{-1}. Impedance data obtained for a sample placed in between two Cu electrodes at different time intervals was used to evaluate the electrolyte – electrode interface. Impedance plots were consisted with two semi circles showing the effects of a surface film and the charge transfer resistance. It could be noticed that both of them increase with time. Investigations are being carried out to fine tune the composition of the electrolyte to have a lower amount of solvents which may affect for surface film and charge transfer resistance.

Keywords: Gel polymer electrolytes, Impedance Spectroscopy, passivation, polymethylmethacrylate

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Statistical techniques to improve the quality of rubber hot water bottles

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This study is mainly concerned about the production of hot water bottles by a bottle manufacturer in Galle. The main problem encountered by the manufacturer was the increase of number of defects in the product. This problem could have been arisen due to variation in the quality of rubber material used. Viscosity, hardness, TS2 and TC90 are four main factors of the rubber compound that needed to be considered. At present, some specific ranges of above factors are used as quality standard limits, but it appears that the values are incorrect. Therefore, this study was conducted to identify appropriate control limits of above factors to get high quality products. The main objective of the research was to reduce number of defects by controlling the limits of four main factors. Descriptive statistical analysis has been used to obtain the appropriate limits for the above factors, and multiple regression analysis technique is used to obtain the regression model which describes the relationship between the defect proportion percentage and the above factors. Simulation techniques were used to compare the number of defects that may be obtained using current range and the proposed range. The improved ranges were used to check whether defects of the production process has reduced.

Key words: Defects, hot water bottle, TS2, TC90

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Example of groups without the strong invariant approximation property

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A countable exact discrete group G has the strong invariant approximation property (SIAP) if and only iff or any Hilbert space H and closed subspace $S \subseteq H$

$$C_U^*(G,S)^G = C_\lambda^*(G) \otimes S$$

for any Hilbert space H and closed sub space $S \subseteq H$. We have shown that lattice in $SL_n(Z)$is an exact group without strong invariant approximation property.

Keywords: Strong Invariant Approximation Property, Uniform Roe algebras, Invariant Approximation Property.

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Some information measures of power-law distributions

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When the probability of measuring a particular value of some quantity varies inversely as a power of that value, the quantity is said to follow a power law. Power laws can be seen very frequently in physics, biology, earth and planetary sciences, economics and finance, computer science and the social sciences. In this paper, several important information measures of power-law distributions are calculated with continuous random variables such as differential entropy, information divergence and Fisher information.

Key words: Differential entropy, Fisher information, information divergence, power-law distributions

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Vision based intelligent guidance system for blind

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This describes the implementation of an innovative intelligent computer program that provides vocal instructions to safeguard a blind pedestrian from incoming moving obstacles such as vehicles. Since it is a fundamental requirement to recognize hazardous moving objects beforehand to produce (vocal) instructions to avoid them, an intelligent computer program was especially developed to recognize dynamic objects by applying a technique called 'optical flow' and capable of predicting the motion path of detected dynamic objects with an innovative technique named Fuzzy Mathematical Modeling. An Artificial Intelligence technique: a Fuzzy Mathematical Model (FMM) that relies on the study of apparent (observed) size variation of the dynamic object. (According to research findings, a fuzzy-mathematical relationship that exists between the m component value and the skewness of apparent size variation graph was discovered, later fetched to a fuzzy-membership function. In addition, it was observed that the c value maintains a relationship in fuzzy-mathematical nature, with both factors m and the initial apparent size of the object; due to a derived relationship.) Therefore, the primary input to FMM is the graph of apparent size change with respective to time, other than the auxiliary input - relative position change on reference frame. These two graphs are prepared by a separate software module named Image Processing Module comprised of efficient image processing enhanced with artificial intelligence techniques. The functionality of Image Processing Module was further improved by applying mathematical and statistical approaches such as density based clustering. Once the motion path of dynamic object is known, the possibility of determining the safety precautions is obvious. The experimental results prove that the precision of the FMM is approximately 92%. This implies that the researchers have achieved their objectives defined in the postulation stage successfully with significant research findings.

Key words: Artificial Intelligence, computer vision, Fuzzy- Mathematical Modeling

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Investigate ARIMA and ARIMAX Models for predicting paddy production in Vavuniya district in Sri Lanka

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In time series analysis, an Autoregressive Integrated Moving Average (ARIMA) modeling technique is used. When an ARIMA model includes other time series as input variables, the model is referred to as an ARIMAX model. The rainfall is the main factor which influences the production levels of paddy which we shall refer to as intervention events. Some of the other important factors are the harvested area, sown area, year of production and Agro-mechanical techniques etc. used. Due to the unsettled situation for last two decades in this district, the data source centers could not collect data in this period to study the production level to implement developing programs particularly rainfall data but harvested area, sown area of paddy yield are available in this period. Although rainfall data is available for a large number of metrological stations in Sri Lanka, Vavuniya district has not been included in their list of stations. Metrological department has developed an advanced substation for this district recently and therefore it was not possible to obtain reliable rainfall data from 1979 to 2010 in Vavuniya district. More sophisticated models could be developed using ARIMA and ARIMAX modeling techniques for the production levels of paddy by using the most correlated factors Sown and Harvested area of paddy production level. We used ARIMAX (0, 1, 1) for Maha season and ARIMAX (2, 1, 0) for Yala season with Sown and harvested areas as covariates. When comparing the ARIMAX covariate model with the baseline univariate ARIMA models, we found that inclusion of covariates improve the fit RMSE by 14.36% for Maha season and 11.32% for the Yala season.

Keywords: ARIMA, ARIMAX, Univariate model and Covar

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Use of Johnson Transformation for Individual and Moving Range control charts in crepe rubber manufacturing process

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Individual and Moving Range (I-MR) charts are generally used for process monitoring where we cannot group observations into rational subgroups or when it's more convenient to observe individual measurement rather than averages of the subgroups. However, the efficiency of I-MR charts is poor when the underlying distribution of data deviates from normality. Process monitoring is very important in rubber manufacturing where data on critical to quality distributes non-normally. No previous work was found applying I-MR charts especially on rubber data which are non-normal in nature. Hence this study was carried out to investigate the effect of non-normal data on I-MR charts and to develop a method to construct I-MR charts for non-normal data. We suggest to construct I-MR charts with Jonson transformed data as a solution for this issue. Performances of I-MR chart were compared with the theoretical standards, under four different cases; simulated non-normal data, real data, Johnson transformed simulated data and Jonson transformed real data. While the simulated non-normal data and real data lead to high Type-I error and low power, Johnson transformed data lead to very low Type I error (<0.001) and power comparable to theoretical standards. Further investigations are in progress with the objective of recommending this methodology for process monitoring in rubber manufacturing.

Key words: I-MR charts, Johnson transformation, process control, rubber manufacturing

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Generating ARGO salinity and temperature contours in Indian Ocean and predicting desired fish species locations

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In this study, Argo temperature and salinity profiles taken from the upper 2000 m of the ice-free global ocean and currents from intermediate depths are used to draw contours. The system interpolates missing data values in the ARGO database using the user selected interpolation technique. Then interpolated data is inserted into the grid and contours of depth values of a given temperature or salinity values are generated according to a user specified criteria. Parameters such as fish density and species richness at different locations can be predicted using these contour plots. Furthermore, the path of the float trajectory plotted by the system would help to identify patterns of sea surface water currents and patterns of air or wind direction. System captures these contour plots for a given time period and generates videos which provides valuable information about environmental changes.

Key words: Argo data, float trajectory, salinity profiles

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Using software engineering approach to construct a light-weight Java compiler

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In early days, compiler development has been a tedious and time consuming task requiring experts such as computer scientists and engineers. For instance, it is said that the development of the first FORTRAN complier has consumed almost 18 man years. Traditionally all phases from lexical analysis to code generation had to be coded for each compiler from the scratch. However, complier development has now become a software engineering task where a compiler developer can use various software tools to build and test a compiler within few weeks. These days, some application developers have also motivated to construct their own compilers before starting software solutions for specific problems. This research study uses the software engineering approach to develop a light-weight Java compiler. We have studied various tools for compiler construction and chosen a tool set comprising JFLEX, JAVA CUP and ASM. It was found that a specific light-weight Java compiler could be structured in few weeks. This project delivered a light-weight Java complier of size less than 1MB, which would require 15MB 1.2_Java compiler otherwise. It can be concluded that the software engineering approach to compiler construction allows the compiler developers to customize or extend an existing compiler to produce a specific purpose light-weight compiler in an efficient and effective manner.

Key words**:** Compilation, intermediate code, Java, software engineering

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Whole grain cereals and health: knowledge, attitudes and practices of Sri Lankan adults

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Whole grain (WG) cereals are recognized sources of bioactive compounds and regular consumption is associated with risk reduction of a number of non-communicable diseases. Little is known about Sri Lankan consumer knowledge, attitudes and practices (KAP) on use of whole grain cereals. The aim of this study was to determine the levels of KAP of urban and rural adults regarding WG consumption and health. A combination of qualitative and quantitative methods was used to gather information. Preliminary market surveys and focus group discussions were conducted to design the survey questionnaire that comprised of sections regarding knowledge, attitudes and practices. Pre-tested interviewer-administered questionnaire was used. Three hundred adults participated in the study representing urban and rural sectors in Sri Lanka. More than half of urban respondents had a good level of knowledge on WG cereals compared to those of rural (30%). Majority of rural respondents (69%) had positive attitudes towards WG consumption ($p<0.05$). Respondents from both sectors showed poor level of practices. Ability of identifying WG and the frequency of WG consumption were reported low among Sri Lankan adults. Majority of adults rated WG as more natural, nutritious and healthy compared to refined cereals. However, respondents demonstrated poor knowledge and practice levels but positive attitudes regarding WG consumption. Rural adults, though they have poor knowledge on WG consumption showed higher positive attitude level than those of urban. The findings of this study suggest the need of strengthening the public nutrition education activities in Sri Lanka to improve the knowledge on WG cereals, and conducting awareness programmes to increase their consumption.

Key words: Refined cereals, rural, urban, whole grains

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Anthropometric parameters and attitudes towards physical exercise among breast cancer patients

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One fourth of breast cancers worldwide are attributed to overweight, obesity and sedentary lifestyle. Waist circumference (WC), hip circumference (HC) and waist to hip ratio (W: H) and Body mass index (BMI) are anthropometric parameters that reflect body fat distribution. This study attempted to investigate the association between various anthropometric characteristics, amount and types of exercise involved during the last two years and attitudes towards exercises among breast cancer patients. Randomly selected, newly diagnosed breast cancer patients (n=80) in the age group of 35-75 years from Cancer Institute Maharagama and few hospitals in the private sector participated in the study. Attitudes towards need of physical exercise, time duration and type of exercises that the patients were involved in were recorded using an interviewer administered questionnaire. BMI≥23 and >25 were considered as overweight (OW) and obese respectively. Over 80cm of WC and W: H ratio of ≥0.80 was considered as risk category, and statistical associations were analyzed. Among the patients, 63.75% had BMI greater than 23 and 25% among them were obese. Among 64% of post-menopausal women 39.6% and among pre-menopausal women 48.1% had BMI above 25 kg/m^2. A significant difference between the BMI, WC and W: H ratio was not observed ($p>0.05$) between pre and post-menopausal women. According to the WC, 66.7% of post-menopausal women and 70.3% of pre-menopausal women were in the risk category. With respect to W: H ratio, 89.6% and 81.5% of post and pre-menopausal women belonged to the risk category respectively. From all the patients only 18.7% were exercising regularly (brisk walking or jogging) for at least 30 minutes, 3 times per week but among them 67% were still either overweight or obese. Majority of the participants were of the opinion that household chores provide adequate physical activity despite leading a sedentary life style. None of the patients were involved in physical exercises such as swimming, cycling and aerobics. Among the anthropometric parameters, W: H ratio was superior to WC ($p<0.05$) and WC was superior to BMI ($p<0.05$) in identifying the increased fat distribution in newly diagnosed breast cancer patients of whom majority were either overweight or obese. Although the majority of participants were either overweight or obese, they were not taking part in appropriate physical exercise programs. The patients lacked knowledge on frequency, duration and the importance of physical exercise in maintaining the correct weight.

Key words: Breast cancer, anthropometric parameters

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Relationship between anthropometric parameters, socio-demographic characters and physical activity: a cross-sectional study among non-diabetic population

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Incidence of obesity in the world has doubled from 1980s to date. Anthropometric assessments are used in assessing obesity and used as an indicator of body fat content. Thus, the objective of the study was to identify the relationship between anthropometric parameters and socio-demographic factors, physical activity in non-diabetic subjects. A cross-sectional study was conducted among 244 subjects (age 20-70 years). Weight, height, Waist Circumference (WC), Hip Circumference (HC) and Mid Arm Circumference (MAC) were obtained then Body Mass Index (BMI) and Waist Hip Ratio (WHR) were calculated. Demographic characteristics and levels of physical activities were obtained using an interviewer administrated questionnaire. Majority were females (61.9%) and Sinhalese (93.9%). Mean (±SD) BMI, WC, HC, WHR and MAC of the male population were 23.9±3.5 kg m^{-2}, 86.9±10.7 cm, 98±7.4 cm, 0.88±0.07 and 30.1±3.0 cm respectively. Mean (±SD) BMI, WC, HC, WHR and MAC of the female population were 24.0±4.3 kg m^{-2}, 80.5±10.9 cm, 96.4±9.3 cm, 0.83±0.08 and 28.7±4.1 cm respectively. There was a significant difference in mean WC (P=0.000) and WHR (P=0.000) among males and females. BMI, WC and WHR had a significant positive (P<0.01) correlation with age among female population whereas males had a significant (P<0.05) correlation with MAC (negative) and WHR (positive) only. Physical activity had a non-significant (P>0.05) negative correlation with BMI and WHR. WHR showed a significant positive association with age among both males and females. However, anthropometric assessments did not indicate significant correlations with physical activity.

Key words: anthropometric measurements, anthropometric indices, demographic factors, physical activity

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Assessment of nutritional status and associated factors among institutionalized elderly in the Galle district

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Senior citizens in a country like Sri Lanka account for a considerable quota of community health because they are more susceptible to health problems. Therefore, we need to reflect on their health status and nutritional status. The aim of this study was to evaluate the nutritional status and associated factors among inmates of selected elders' homes in Galle district. A descriptive, cross-sectional study was conducted among 169 institutionalized older persons from selected elders' homes in Galle district. An interviewer-administered questionnaire was used to collect information on the study variables and the nutritional status was assessed using the Mini Nutritional Assessment (MNA) questionnaire. Data were analyzed using SPSS statistical software package. The study participants had a mean age of 72.38±10.63 years: of them 71.8% were females and 28.2% were males. According to MNA, 44.4% of them were malnourished, 46.1% were at risk for malnutrition and only 9.5% were well nourished. The factors associated with poor nutritional status included presence of mental health problems, problems of gastro-intestinal tract and a high cholesterol level ($p<0.05$). In addition, eating dependency and mobility dependency were significantly associated with poor nutritional status ($p<0.01$). The age and gender of inmates and being in a crowded home (>30 inmates) were not associated with their nutritional status. This study reveals that the nutritional status is not satisfactory among the inmates of elders' homes in Galle and is affected by many health related factors. Regular nutritional screening and correction of health problems will be beneficial to improve their nutritional status.

Key words: institutionalized elderly, Mini Nutritional Assessment, nutritional status

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Pattern of consumption of sweetened foods/ drinks by type 2 diabetic patients of a selected study center

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Sri Lanka is among the countries with a high prevalence of diabetes with one in five adults being either diabetic (DM) or pre-diabetic and there is a rapid incline of this health burden. Excessive sugar consumption may lead to persistent high blood glucose in diabetics due to less glucose clearance owing to their insulin resistance/insensitivity, leading to diabetes related complications. Excess glucose increase fat deposits causing overweight and obesity. Thus control of sugar consumption in diabetics is necessary. A Sri Lankan adult consumes approximately 16 teaspoons of sugar daily (recommended amount 6-9 teaspoons). However, no reported data on sweet drink or food consumption by diabetics is available in our country. The present study aims to observe the consumption of added sugar (to coffee/ tea etc.), sugar from other sweetened food (malted drinks/ soft drinks/ biscuits/ jams and cordials/ chocolates and other sweets) and use of non-caloric sweeteners by type-2 diabetics (n=90) in a selected group of individuals. An interviewer-administered pre-tested and validated questionnaire was used. Amount of sugar in foods were calculated using the data available in food based dietary guidelines of the Health Ministry of Sri Lanka. From the study population (age 35-70 years; mean age 55±9 years; males=40; females=50), 10% had been diagnosed within 1 year while 56% and 34% had been suffering from diabetes for 1-10 years and more than 10 years, respectively. Majority (99%) in the present study consumed normal sweetened foods instead low/non caloric foods. Though urban residents, none of the patients used non-caloric sweeteners. Consumption of high amount of sweets (taken once or more than once/day) was only by 3% while 77% consumed very low amount of sweets (any sweetened food or beverage once or less than once/week). Two thirds of the study population (66%) did not use sugar in tea and only 8% used more than two teaspoons of sugar for tea. The amount of sugar obtained from other foods was approximately less than 2 teaspoons/day for 56% of the population. Sugar intake of the diabetic patients of the present study was in accordance with Sri Lankan clinical practice guidelines (50g/day). The present study revealed that the non-caloric sweeteners were not popular among Sri Lankan diabetics despite the recommendation. Educating the patients of the benefits of use of non-caloric sweeteners to curb instances when they crave for sweets could further reduce the sugar intake as well as improve the quality of life of diabetics.

Key words: non-caloric sweeteners, sweetened foods, sugar consumption, type 2 diabetes

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The effect of herbal porridge made with *Scoparia dulcis* on lipid profile of type 2 diabetics

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Porridge made of *Scoparia dulcis* (Walkoththamalli) leaves elicited a high anti-hyperglycaemic effect and also caused an elevation in HDL-C concentration in diabetes induced Wistar rats. Thus the present study was carried out to investigate the lipid lowering effect of the *Scoparia dulcis* porridge in diabetic patients after consuming it for three months. Porridge was produced by incorporating *Scoparia dulcis* fresh leaves: rice: scraped coconut kernel in 13-15:25-30:10-13 (w/w/w) ratio using a commercial production method. Study was a randomized crossover study with 35 patients with type- 2 diabetes. The test group (mean initial fasting blood glucose (FBG=176±53) was advised to consume the *S. dulcis* porridge (40g porridge/ 350 mL hot water) once a day for 3 days/week for three months, and control group (mean initial FBG=174±55) was advised to consume a normal breakfast except a green leafy porridge. At the onset and end of each month, serum total cholesterol (TC), HDL-C and triglyceride concentrations were estimated by enzymatic kit methods and LDL-C, TC:HDL-C and LDL-C:HDL-C were calculated by the standard equations using the above parameters. A significant difference was not observed between the test and the control groups ($p>0.05$) for the lipid parameters except for an increment percentage of HDL-C. TC and LDL-C were above the upper limit of normal reference range for diabetics (TC>200mg/dL; LDL-C>100mg/dL) and TG was at the upper limit of normal reference range (165mg/dL) at 0 and 3 months for both control and test groups (at 0 month: TC= test 226±57.7, control 225±54.4; LDL-C= test 154.7±49.9, control 149.7±52.2; TG= test 152±59.6, control 161±74.0 and at 3rd month: TC= test 232±49.0, control 229±41.4; LDL-C= test 160±43.5, control 151.2±34.5; TG= test 153±75.4, control 183±81.6). Percentage reductions of the TC, LDL-C and TG values from 0-3 months between test and control groups were not significant ($p>0.05$). However, the increment percentage of HDL-C was significantly higher ($p<0.05$) in the test group (3.3±18.3) compared to the control group (-5±11.6). No significant difference ($p>0.05$) was observed in the cholesterol ratios (TC:LDL-C, TC:HDL-C and LDL-C:HDL-C) between the test and control groups as well as before and after three months treatment. However, when considering the LDL-C:HDL-C ratio of patients in the test group, the percentage of patients with low CVD risk increased with a corresponding decline in the percentage of patients in high risk category which was not observed in the control group. It can be concluded that consumption of *Scoparia dulcis* porridge at the dose given could contribute to elevate HDL-C concentration in diabetic patients.

Key words: BMI, Cholesterol, diabetes, green leafy porridges, *Scoparia dulcis*, waist to hip ratio

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Association between the anthropometry of mother and newborn from selected Medical Officers of Health divisions of Jaffna District

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Objective of this study was to estimate the influence of variation in anthropometric measurements of pregnant mothers on the birth weight (BW) and length of the newborns from selected Medical Officers of Health (MOH) Divisions of Jaffna District. In this study, 420 mothers were selected in six MOH divisions in Jaffna District. Weight and height of the pregnant mothers were taken in antenatal clinics at third trimester of gestation while that of the newborns was collected immediately after the birth. Ethical approval was obtained from ethics review committee, Faculty of Medicine, University of Jaffna, Sri Lanka. Data was analyzed using SPSS version 16 software. Among the 420 newborns, 212 were females (50.5%). Mean BW of the newborn was 3027.51(±431.61) g, ranging from 1500.0 to 4550.0 g and the mean length was 50.9 (±2.1) cm, ranging from 44.0 to 57.0 cm. Among the newborns, low, normal and high birth weights were 11.4 (n=48), 88.3 (n=371) and 0.3 % (n=1) respectively. Mean weight and heights of pregnant mothers were 63.02 (±11.56) kg and 154.39 (±6.00) cm respectively and the mean BMI was 26.42 (±4.42) kg/m^2. Among the pregnant mothers, the rate of under, normal and obese/overweight were 1.0 (n=4), 22.0 (n=93) and 77.0% (n=323) respectively. Neonatal length positively correlated with their BW (r=0.506, p=0.0001). Maternal BMI was positively correlated with neonatal BW (r=0.292, p= 0.001) and length (r=0.135, p= 0.006) of the newborn. Based on this study, variation in height of mother positively correlated with the BW (r=0.293, p=0.001) and length (r=0.12, p=0.02) of the newborns.

Key words: Anthropometry, Jaffna District, mother, MOH divisions, newborn

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Thrips infesting flowers of cowpea, yard-long bean and mung bean at selected localities in Monaragala district of Sri Lanka

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In southern Sri Lanka, information on flower-infesting thrips in food legumes is scarce. In this study, species composition, distribution and degree of damage in flowers of cowpea, yard-long bean and mung bean were determined at 35 farmer fields located in Monaragala District. The survey was conducted over a period of one year and each farmer field was surveyed only once during the study. Fourteen cowpea and yard-long bean, and seven mung bean fields at six major locations, i.e., Thanamalwila, Hadapanagala, Athimale, Buttala, Kudaoya and Monaragala, were sampled. At least five plants per field were randomly selected and at least three flowers were sampled per plant. Collected adult thrips were slide-mounted and identified using Lucid keys. *Megalurothrips usitatus* was the only thrip species present in all three legume species. Thrips infestations were found in all the fields sampled. In Cowpea, at seven fields (representing 50% of the fields), 100% of the sampled plants had thrips infestation while in yard-long bean, ten fields (71%) had 100% infestation. In mung bean, only two (28.57%) had 100% infestation. Among the flowers of three legume species, the highest overall flower infestation (78.06±5.61%) was found on yard-long beans followed by cowpea (73.64±5.31%). In mung bean, the flower infestation was 66.03% (± 8.26%). Infestation in open flowers was found to be significantly higher than in flower buds with the highest infestation (69.6±3.59%) in yard-long bean. The highest percentage of bud infestation (32.02 ±7.93%) was recorded on mung beans.

Key words: Food legumes, infestation, *Megalurothrips usitatus*

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Range expansion of invasive alien sailfin catfish *Pterygoplichthys* species in Sri Lanka

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South American sailfin catfish (*Pterygoplichthys*) popularly known as tank cleaner is one of the accidently introduced invasive fish into the natural freshwater habitats of Sri Lanka. External morphological analysis showed the presence of two *Pterygoplichthys* species (previously misidentified as *Hypostomus plecostomus*) in Sri Lankan waters, namely *P. disjunctivus* and *P. pardalis.* According to the national list on invasive alien fauna (2011), sailfin catfish was found in freshwater habitats in the Western and North-western provinces of the country. This study was conducted from September 2012 to August 2013 in 76 freshwater sampling sites including canals, streams, rivers, reservoirs, marshes, flood plains in Central (CP), Eastern (EP), North-central (NCP), North-western (NWP), Sabaragamuwa (SBP), Southern (SP), Uwa (UP) and Western (WP) provinces aiming to detect and map natural range expansion of sailfin catfishes. Fish were caught using cast net and electro fishing device. Two hundred and eight fish were caught during the study and their total length ranged from 5.6–46.6cm. Sailfin catfish has increased its natural range from North western and Western provinces into Central, Eastern, North-central and Uwa provinces. Out of 76 sampling sites surveyed, 46(60%) sites had well established sailfin catfish populations. They inhabit perennial reservoirs, tanks, irrigation cannels, flood detection areas as well as rivers, streams, marshes and flood plains. The fish has shown adaptations to flourish in comparatively unpolluted environments such as perennial reservoirs (in NC province), Attanagalu Oya-Upper reach (Weeragula), as well as highly polluted environments i.e. Hali-Ela (in CP), Bellanwila-Attidiya marsh (in WP). It was also recorded in a brackish water cannel in Pamunugama, Gampaha, and this was the first record of occurrence of sailfin catfishes in brackish waters in the country. Sailfin catfishes were not recorded in Sabaragamuwa, Southern, Uwa, Eastern and Central provinces. Further studies to identify the factors that affect the range expansion of this invasive fish in Sri Lanka are warranted.

Key words: Distribution, invasive, *Pterygoplichthys*, tank cleaner

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Impact of Glyphosate (Round-up) on the diversity of invertebrate in terrestrial habitats and the Phosphate level of adjacent waters

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Glyphosate is one of the most commonly used herbicides in the world. Effect of Glyphosate on abundance of selected arthropods under five orders which belong to class Insecta (Coleoptera, Hemiptera, Lepidoptera, Orthoptera, Diptera) and class Arachnida were studied for a period of three months in a selected non-agricultural site using two different concentrations of Roundup (Glyphosate). After application of Glyphosate, the abundance of all tested arthropods reduced (ANOVA, $p \leq 0.05$) in treated plots compared to that in untreated plots. With time, the weeds started to reappear and the abundance of beetles, weevils and bugs increased gradually. Meanwhile the abundance of butterflies, moths, dipterans, grasshoppers and ants inhabited in treated area reduced significantly ($p \leq 0.05$) even after the reappearance of weeds in the experimental plots. The fresh water samples collected from the vicinity of the study site indicated a continuous increase of the concentration of inorganic phosphate. This reveals a possible Glyphosate contamination of water.

Key words: Arthropods, Glyphosate (Round-up), Phosphate concentration

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Sexual size dimorphism and feeding of *Hydrophis spiralis* (Shaw 1802) occurring along the Vadamaradchy coastline of Jaffna, Sri Lanka

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There are no previous records on the sexual size dimorphism in the sea snake *Hydrophis spiralis* (Shaw 1802). However, there are reports that head shape differences in sea snakes are related to differences in consumed prey type or prey shape. The aim of the present study was to find out sexual dimorphism in external morphology and some aspects of feeding of *H. Spiralis* (Elapidae) in the waters of Vadamaradchi division of the Jaffna Peninsula. Sea snakes were collected from fisheries by-catch once a week from December 2011 to July 2012. Out of a total of 75 specimens of *H. spiralis* collected, 31 were males and 44 were females. Various head and body measurements were taken (mm) and morphological differences between the male and female snakes were compared by *t*-test. The degree of size dimorphism between males and females of adults pertaining to head, body lengths and scale counts were quantified by the sexual size dimorphism index (SDI). To find out the feeding differences among sexes, the stomach of every snake was pressed gently to release the prey items. The number of fish present in the gut, status of feed and direction of prey were recorded. Chi-square test was employed to both sexes to find out the food intake pattern, proportion of having empty stomach and head size of the snake against the prey items. Seven out of 13 morphological characters were significantly different (*t*- test, $P<0.05$) between adult males and females (total length, head width, length between snout-eye, inter-orbital, eye-width, inter-nostril lengths and number of ventrals). Four out of 13 characters namely vent-tail length, inter-nostril, eye-width and sub-caudal count showed male-biased and the rest were female biased SDI value, and the mean degree of sexual size dimorphism of *H. spiralis* is 0.2953. Analysis of feeding revealed that the preys composed of two fish families namely Muranidae and Congridae. There were no significant differences between the proportion of males and females with empty stomach or the direction of food intake and head size with the prey type among sexes (Chi square test). Both sexes consume fishes with the same shape. In conclusion, this study reveals that adult females of *H. spiralis* are 29.53% times longer than adult males. Even though sexual size dimorphism is prominent in *H. spiralis*, no significant differences were observed in the feeding of male and female snakes.

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Geometric morphometric analysis of selected populations of *Puntius chola* (Cyprinidae) in Sri Lanka

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Intra specific variation of *Puntius chola* (Cyprinidae) of six geographically different populations (Nilwala River, Walawe River, Gin River, Kalu River, Malwathu Oya, Deduru Oya) of Sri Lanka was studied using landmark based geometric morphometric technique (GM) (n=20 from all rivers; n=21 from Gin River). The method is aimed to detect the variation in shape of fishes unhindered by the size factor. Procrustes ANOVA revealed significant differences among populations ($p<0.05$). The first two canonical variates (CV) explained 66.7% of the total variation in the data and the plot of the CV revealed significant separation of some of the populations. In this regard, CV1 indicated clear separation of Deduru Oya population from Malwathu Oya, Walawe River and Gin River populations while CV2 axis separates Nilwala River population from Malwathu Oya, Deduru Oya, Kalu River and Walawe River. Transformation grids indicated that head morphology and length of dorsal fin has mostly contributed for the shape variations detected. Mahalonobis distance values revealed that Deduru Oya and Gin River populations as the most separated populations while Malwathu Oya and Walawe River population as the most related populations. Some of the relationships cannot be explained using present day geographic distance, and therefore, some historical factors may have contributed for the differentiations observed. In conclusion, the present results reveal significant morphological heterogeneity among *P. chola* populations in Sri Lanka, and it is of scientific interest to investigate if these populations are genetically divergent as well.

Key words: Geographic isolation, geometric morphometrics, morphological heterogeneity

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A Survey of bird diversity in paddy fields in "Kirala-Kele" and Bandaththara, Matara, Sri Lanka

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This study examined avian assemblages of working and abandoned paddy field areas situated in "Kirala-Kele" wetland and Bandaththara marshland area of Matara, Sri Lanka. Birds were observed and recorded along pre-established belt transects (100 m length 50 m width) during 52 visits for two years. Highest number of bird species recorded was 55 from an abandoned paddy field area dominated by *Sonneratia caseolaris* vegetation and lowest number of bird species recorded was 35 from an abandoned paddy field area dominated by grasses. Totally, 48 species of forest birds and 36 species of waders were recorded during the study. Two near threatened species (Painted stork and Black-headed ibis) were recorded from the Paddy field area located outside of the "Kirala-Kele" wetland. Three near-threatened species (Painted stork, Black-headed ibis and Oriental darter) and one restricted-range species (Sri Lanka Hanging parrot) were recorded inside the "Kirala-Kele" wetland. Great egret, Intermediate egret, Little egret, Cattle egret, Indian pond heron, White-breasted water hen, Purple swamp hen, Little cormorant, Jungle crow and House crow were the dominant species recorded from all study areas. Highest bird species diversity was recorded in the paddy field areas of Bandaththara area indicating the importance of these habitats as avian feeding grounds. Mainly omnivorous and carnivorous feeding assemblages were observed in every study site. Roosting assemblages were mainly observed in "Kirala-Kele" study sites. Working paddy fields supported a varying number of species with respect to seasonal cultivation cycle while abandoned paddy fields supported a year-round consistent number of species.

Key words: Birds, diversity, "Kirala-Kele", paddy fields, wetlands

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Study of ectoparasites associated with wild murid rodents in a selected area in Matara: A preliminary study

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A study of murid rodents was carried out from February to August 2012 in five different habitat types located within Matara area. Objective of the study was to identify the available murid species and their ectoparasitic fauna. Collection of the murids was done using a standardized arrangement of Sherman live traps using two types of bait, namely roasted coconut and dried fish. In 560 sampling occasions, 130 individuals of family muridae were captured. The species were *Rattus rattus kandianus*, (n=95), *Mus mayori mayori* (n=4), *Rattus norvegicus* (n=26), *Bandicota indica indica* (n=3), *Vandeleuria sp* (n=1) and *Millardia sp* (n=1). Among all captured murids, 54 were females and 76 were males. The number of species captured in different sites were, four species in paddy field associated habitat (n=24), three species in town area (n=23), three species in dumping sites (n=22), two species in Kekanadura forest edge (n=30) and all six species in Kekanadura forest (n=31). Ectoparasitic investigations indicated that out of the 130 individuals captured, 62.3% were infested with two types of ectoparasites, namely, mites of the genus *Echinolaelaps*, and nymphal stage of hard tick genus *Ixodes*. The incidence of parasitized rats and mice were 67%, 65%, 36%, 70% and 68% respectively from paddy field (n=16), town area (n=15), dumping sites (n=8), Kekanadura forest edge (n=21) and Kekanadura forest (n=21). Among the infested murids, 78% had mite infestations. In comparison with the non-infested murids, those infested did not show a significant difference in body weight and size. Both sexes of captured murids had an equal probability of being exposed to ectoparasites.

Key words: *Echinolaelaps*, ectoparasites, *Ixodes*, Murid rodents

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Growth performance of *Oreochromis mossambicus* fingerlings and of spinach plants grown on two substrates in aquaponic system

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Aquaponics is a developing agricultural technology that is rapidly gaining worldwide popularity, both for commercial production and small-scale, backyard systems. The aquaponics concept involves integrating aquaculture and hydroponics, where fish wastewater is utilized as a nutrient source for plants grown in soilless culture. Present study was carried out to assess efficiency of two types of plant beds i.e. coir peat & saw dust in terms of nutrient removal and to assess growth and survival of fish (*Oreochromis mossambicus*) and growth of spinach plant in aquaponic system. Single aquaponic system consists of a fiberglass tank with fish, spinach plants grown in three types of plants beds i.e. 50%coir dust + 50% soil, and 50% saw dust + 50% soil are considered as the two treatments, while 100% soil was considered as the untreated control. Each treatment was triplicated and the experimental design was a complete block design. Drained water from plant beds was re-circulated into the fish tanks. There is no significant difference ($p > 0.05$) of plant biomass and the height increments of the plants in three different beds. However, there is a significant difference ($p < 0.05$) in fish biomass changes in three different treatments but there is no significant difference in the total length increase in them. Data revealed that the coir dust which is considered as a waste from coir string industry can be used as plant bed substrate in aquaponic systems.

Key words: Aquaponics, hydroponic, nutrient, plant bed media

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Growth effects and erythrocyte nuclear abnormalities in juvenile *Oreochromis niloticus* experimentally exposed to crude oil

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Crude oil contains genotoxic and carcinogenic substances that can bring about hazardous effects on organisms at different levels. The objectives of the present study were to investigate long term effects on growth of juvenile *Oreochromis niloticus* fish exposed to crude oil under laboratory conditions, and to test whether the exposure to crude oil educe any signs of genotoxicity in the fish, using erythrocyte nuclear abnormalities (ENA) as biomarkers. Three experimental groups in triplicate were maintained over 90 day period as freshwater control (N), 5ppm crude oil (T1) in water (V/V%), and 25ppm crude oil (T2) in water, with addition of 35 live fish into each tank under semi-static exposure conditions. Fish were sampled (n=20 per tank) at 18 day intervals for growth estimation. Giemsa-stained smears of peripheral blood and cephalic kidney from each fish (n=6 per group) were prepared on completion of 90 days, and occurrence of abnormal cells under four different categories (micronuclei, nuclear buds, fragmented apoptotic nuclei and altered nuclei) was examined. The results revealed that growth rates in weight and length, and specific growth rates over 90 day period were significantly lower in both crude oil exposed groups than in the control group ($p<0.05$), indicating a significant growth retardation upon exposure to crude oil. When compared with control group, there was a significant increase in the frequency (per 1000 cells) of erythrocyte nuclear abnormalities in fish exposed to 5 ppm (T1) and 25 ppm (T2) of crude oil. There was a significantly higher frequency of all ENA types in T2 group compared to T1 group as well. The comparison of the different ENA types between the peripheral blood and cephalic kidney within each experimental group showed significantly higher induction of all ENA types except altered nuclei (AN) in the cephalic kidney in the crude oil exposed groups. In conclusion, exposure to crude oil caused significant growth retardation and higher induction of ENA in juvenile *O. niloticus*.

Key words: crude oil exposure, Erythrocyte nuclear abnormalities, growth impairment

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Market chain assessment of the Blue swimming crab industry in Jaffna, Sri Lanka

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Warning signals given by European Union to Sri Lankan sea food exports, especially for blue swimming crab (*Portunus pelagicus*), on Illegal Unreported Unregulated (IUU) fishing practices is a crucial issue thus, branding the Sri Lankan exports, as "Marine Stewardship Council (MSC)", may show the commitment of Sri Lankan industry for sustainable utilization of the resource. Poor understanding of the crab market as a whole is one of the preliminary requirements but a main constrain in stepping towards in gaining the MSC certification. Therefore, this study tried to formulate the market chain structure in identifying the size; capacity and connections of each layer of the market chain giving special emphasis on potential strengths, weaknesses, opportunities, and threats in gaining the MSC certification. Primary data were collected through personal interviews, semi-structured questionnaires, direct observations and group discussions, from June to September, 2013, covering 90% of randomly selected market chain actors engaged in the crab industry in Jaffna. Secondary data on prices of crabs in the local market, information on fishing families and fishermen cooperative societies were obtained from the Department of Fisheries and Aquatic Resources in Jaffna. The recent expansions of fishery and shifting the industry towards "Export market" from "Self consumption" have initiated a large number of community-based management societies which has similarities as well as differences in their management strategies. Two different market chains were identified for the blue swimming crab industry; the domestic market chain and the export market chain. The local market is price oriented with low emphasis on quality while the export market is highly regulated. The export market stands for quality with high prices. While concerning the increase revenues of the crab fishery it is essential to make structural changes throughout the market chain especially for the export market. Such changes should be implemented on the methods, practices, market chain actors and even on equipment. In addition, possibilities of quality improvement and cost reduction in local market were revealed. Lack of knowledge and lack of trust between actors were identified as major barriers in the expansion of crab industry as well as working towards in gaining the MSC certification.

Keywords: Crab fishery, export market, market chain, MSC, *Portunus pelagicus*

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Nutritional and Anti-nutritional contents of alternative plant feed ingredients for fish feed formulation

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This study emphasizes the importance of plant sources as alternative ingredients for formulation of fish feed instead of high cost fish meal. In the present study, leaves of sweet potato, banana, soybean, salvinia, papaw, *Gliricidia*, Habarala, and jack seed powder were used. Those ingredients were subjected to proximate analysis and mineral analysis and also evaluated for the presence of anti- nutrients such as Saponin, Phytic acid and Cyanide. The protein content in those ingredients was estimated to be in between 9.66-29.32g/100 g and the range of crude lipid was recorded as 0.8- 11.6 g/100 g. The results showed the moisture content and ash content of the ingredients to be as 73.75-93.00 g/100 g and 5.21-19.24 g/100 g respectively. The analyzed ingredients had trace amounts of Na, P and K which ranged between 0.49 – 2.71 g/100 g. All the tested ingredients contained Saponin (0.79- 5.58 g/100g), Phytic acid (0.07- 0.81g/100g) and Cyanide (56.50-436.50 mg/100g). According to the nutritional composition results, some of the plant based ingredients can be used for the fish feed preparation.

Key words: Anti-nutrients, Cyanide, Phytic acid, proximate analysis, Saponin

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An assessment of the bacterial quality of water, ice and fish in a fishery harbour in Southern Sri Lanka

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The fisheries sector plays an important role in the Sri Lankan economy. However, the post-harvest quality of our local fish production seems unsatisfactory. Furthermore, the sanitary conditions of the fishery harbours and the fish landing sites also appear to be unhygienic. The objective of this study was to assess the bacterial quality of water, ice and fish at a fishery harbour located in the Southern region of Sri Lanka. Water samples were collected from the jetty area (A), oil-spilled area (B), tap water (C) and area where single-day boats were landed (D). Fish samples (n=8) were collected from single-day boats and multi-day boats. All three types of samples were collected during the period from June to July, 2013. The degree of bacterial contamination of harbour water at different locations was statistically analyzed. *Escherichia coli* (*E. coli*), other coliforms, *Pseudomonas* and *Bacillus* spp. were isolated from the harbour water. The bacterial contamination of A was significantly ($p<0.05$) higher compared to that of B and D. Interestingly, there was no significant difference between the bacterial contamination of jetty-water and that of tap water. Bacterial counts carried out with tap water showed very high bacterial counts and were positive for *E. coli*, which proved unacceptable for drinking. The bacterial contamination of ice was also significantly ($p<0.05$) higher compared to that of harbour water. Thus ice produced at the harbour can be a potential source of bacterial contamination for post-harvest fish. Fish from both single-day boats and multi-day boats (before and after washing) showed very high bacterial contamination. Washing with harbour water does not help to reduce the bacterial contamination of post-harvest fish.

Key words: bacterial contamination, harbour-water, post-harvest fish

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Unforeseen problems experienced in experimental cage culture: lessons for future cage culture

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Growth performance of Genetically Improved Farmed Tilapia at three different stocking densities (50, 75 and 100 fish m^{-3}) in triplicates were evaluated in a cage culture unit of nine cages established in a perennial reservoir in Hambantota District. Nylon material having mesh size of 10 mm recommended for cage culture was used. Fingerlings (6750) were stocked in nine cages, fed with a formulated diet according to the body weight using feeding trays. Monthly samples from each cage were weighed and the study conducted for four months. In all cages, monthly mean weight increase was very low. Cages with low stocking density had the highest weight gain while high density had the lowest. Specific growth rate (SGR) in fish of all nine cages increased in the first month and then gradually decreased during subsequent months. Wild fish (*Puntius dorsalis, P. singhala, Rasbora daniconius, Devario malabaricus, Glossogobius sp., Esomus sp.*) entered into cages in large numbers had contributed to decrease in SGR. Highest weight of the wild fish was recorded in the second month and reduced in subsequent months due to regular inspection. Effective increase in SGR however was not observed. In two cages having 100 and 75 fish m^{-3} showed an increase in SGR in last two months which was not observed in other cages. This effect relates with the changing of the water current in the reservoir into opposite direction resulting water entering firstly into these two cages making a rapid increase in fish weight. Awareness of changing water current patterns in the reservoir and positioning the cages accordingly is an important issue to be considered in commercial cage culture. Use of 5mm mesh size is recommended to avoid wild fish invading the cages and has proven a good harvest.

Keywords: Cage culture, GIFT, specific growth rate, water current, wild fish

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Market chain analysis of edible oyster in Sri Lanka: a case study at Puttalam lagoon

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Small scale fisheries play a major role in global fish production, especially in developing countries like Sri Lanka. The bivalve fishery, which consists of both capture-based aquaculture and capture fishery from natural oyster beds, is one of the promising small scale fisheries among poor coastal communities in Sri Lanka. However, this industry has not been developed into mass scale production, despite the availability of a large number of water bodies and natural bivalve beds, due to poor knowledge on the potential for expansion of the market chain. Therefore, this study tried to identify the strengths; weaknesses; opportunities; and threats in each phase of the market chain. Primary data were collected through field visits at oyster landing sites in Gangewadiya (mainly *Crassostrea madrasensis*) and Kandakuliya (mainly *Crassostrea belcheri*) in Puttalam lagoon, on production locations; processing units; and markets by interviewing, all most all the market chain actors engaged in the industry, from February to November in 2012.The main stakeholders in the oyster market chain were identified as oyster harvesters and farmers; processors; agents; exporters and consumers. However, a well-organized market structure was not evident. Almost 90% of the local market depends on the tourist industry while one export company has entered the market chain recently. The local market has given low emphasis on quality while the export market is characterized by demand for good quality and high prices. The main obstacles for expansion of the industry are the lack of knowledge and unstructured flow of information among farmers, harvesters, processors and exporters, and lack of trust between actors. A significant number of processors, agents and exporters believed that there is a high potential for developing the bivalve industry, but majority of farmers doubt on such development due to high mortalities prevalent during the monsoonal period. However, inadequate legislation on uncontrolled harvesting of wild oyster population during the monsoon period was the major concern of environmentalists. If an alternative could be found through future research to maintain a continuous supply of oyster during the monsoon periods, there exists a high potential for developing the bivalve culture as a continuous foreign income generating industry.

Key words: *Crassostrea belcheri*, *Crassostrea madrasensis*, market chain, small scale fishery

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Investigation of the possibility of utilizing two mitochondrial gene regions to differentiate two *Penaeus* species: A preliminary study

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Black tiger prawn *Penaeus monodon* and Green tiger prawn *P. semisucatus* show similar morphological characters up to some extent thus are difficult to differentiate them especially at their larval stages. This preliminary investigation focused on the possibility of utilizing genetic based approach to distinguish the above two *Penaeus* species. Two mitochondrion gene regions i.e. 12S rRNA and 16S rRNA, were partially amplified using universal primers and sequences were obtained for analysis. For 12S rRNA gene region, the percentage of base composition for *P. monodon* was A: 34.79%, C: 11.34%, G: 17.78%, T: 36.08% and for *P. semisulcatus* it was A: 36.36%, C: 13.51%, G: 17.40% and T: 32.73%. For 16S rRNA gene region the percentage of base composition for *P. monodon* was A: 34.43%, C: 12.70%, G: 18.85%, T: 34.02% and for *P. semisulcatus* it was A: 33.40%, C: 12.09%, G: 20.70% and T: 33.81%. Genetic distance (p distance) between *P. monodon* and *P. semisulcatus* was 18.4% and 8% for 12S rRNA and 16S rRNA gene regions respectively. The utility of restriction enzymes to discriminate these two *Penaeus* species was investigated and possibility of application of three restriction enzymes on this purpose was determined. *P. monodon* shows high growth rate compared to *P. semisulcatus* thus extensively used in aquaculture industry. Therefore, correct identification of two *Penaeus* species is important when selecting brood stocks and the larval stages from the wild catch for culturing purposes.

Keywords: 12S rRNA and 16S rRNA, mitochondrial genes, *Penaeus monodon*, *P. semisulcatus*

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Development of fibre rich soft dough biscuits fortified with *kohila* (*Lasia spinosa*) flour

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Currently there is a growing demand for fiber-fortified food products in the world to prevent from non-communicable diseases. To develop high fiber soft dough biscuit, kohila flour was added to biscuit formulation at 10% and 15% levels (w/w), respectively. Sugar was substituted with sucralose (1g) to obtain a low energy product. The chemical and proximate composition of the product (moisture, pH, protein, fat, ash, dietary fiber, carbohydrate, sodium and heavy metal, antioxidant capacity) was determined. Sensory evaluation was carried out by a panel of thirty sensory panelists, using a paired preference test and hedonic test to select the most preferred sample with the best sensory attributes. A market survey was done by using sixty sample sizes to evaluate the consumer preference for the prepared biscuit. Results showed that kohila flour fortified biscuits contained significantly ($p<0.05$) high amount of fibre (7% (w/w), on dry basis). High amount of iron (48% ppm, dry basis) contained in fortified biscuits while toxic heavy metal as As, Pb and Cd were absent. The antioxidant capacity (Radical DPHH scavenging capacity) was as high in kohila flour added biscuits (20-23%). The10% kohila flour added biscuits yielded the highest consumer acceptability. Survey results showed that there was a correlation between preference for sucralose added biscuits and health condition ($p<0.05$) of the consumers. The preference for fiber-fortified biscuits and sucralose added biscuits were high in consumers with higher level of education. Findings of this study revealed that kohila flour fortified biscuits can be used as a valuable source of dietary fibre which is beneficial to improve the health of the consumers.

Key words: Antioxidant, dietary fiber, non-communicable diseases, soft dough biscuits, consumers

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Performance of murrah, surti, nili-ravi buffaloes and their crosses in a large scale farm in the intermediate zone of Sri Lanka

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The objective of the study was to evaluate productive and reproductive performance of Murrah, Surti, Nili-Ravi buffaloes and their crosses in a large scale farm in the intermediate zone of Sri Lanka. Records on age at first calving, calving interval, lactation length, dry period, lactation number, milk yield per day, milk yield per lactation, and birth weight were collected for the period of 1993-2013 from a large scale farm in the intermediate zone of Sri Lanka and analyzed using the statistical package SAS 9.1. The least square mean and standard error for production traits of total milk yield, lactation length, calving interval and birth weight were 1187.65 ± 21.08 kg/lac, 269.08 ± 2.50 days, 469.46 ± 4.86 days, and 27.67 ± 0.12 kg respectively. The least square mean and standard error of age at first calving and dry period were 48.38 ± 0.30 months and 178 ± 4.33 days respectively. Milk yield was not significantly influenced by genetic and non-genetic factors. Lactation length was influenced by year of calving, year of dry off, dry period and sex of the calves. Calving interval was significantly influenced by breed and parity. Both birth weight and age at first calving were significantly influenced by breed and year of calving. Dry period was significantly influenced only by lactation length. It could be concluded that the absence of breed differences for the major productive trait milk yield is not a good indication of breed improvement. Corrective measures should be taken as soon as possible to rectify the shortcoming through planned breeding and selection, improved feeding, housing and health care management.

Key words: Murrah, Nili-Ravi, productive traits, reproductive traits, Surti

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Effects of plant spacing on yields and nutritive values of hybrid Napier grass CO-3 in dry zone of Sri Lanka

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An experiment was conducted to study the effect of spacing (60cm X 60cm, 60cm X 90 cm) on yield, growth parameters viz. fourth leaf length, fourth leaf width, plant height, number of leaves per plant and number of tillers per plant and nutritive values viz. crude protein (CP), crude fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF), and ash content of CO-3 fodder grass during May-July 2013 at Regional Agricultural Research and Development Centre, Killinochchi, Sri Lanka. The experiment was conducted using complete randomized block design with four replicates. Fresh matter yield at 60 days after harvesting was not influenced by spacing. All growth parameters showed significant increase with two weeks interval up to 60 days. Crude protein (CP), crude fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF), and ash content were not significantly influenced by the plant spacing used in this experiment. Results concluded that spacing could be increased (60cm x 90cm) than recommended spacing (60cm x 60cm) without significantly affecting yield and nutrient composition of CO-3 in the dry zone of Sri Lanka.

Key words: CO-3, growth parameters, hybrid Napier, nutritive value, yield.

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Efficacy of different bio-rationals against Papaya mealy bug *Paracoccus marginatus* (Hemiptera: Pseudococcidae)

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Papaw mealybug, *Paracoccus marginatus* causes severe economic losses mainly in papaw, *Carica papaya*. Symptoms such as yellowing, crinkling and distortion of leaves, sooty mould development and yield losses have been reported resulted due the heavy feeding of Papaw mealybug. Considering the seriousness of the damage and environmental safety, six bio-rationales such as fermented neem leaves solution (1 g/ml), neem leaf extract (20 g/ml), *Pavetta* leaf extract (20 g/ml), garlic extract (*20 g/ml*), vermi wash and fermented cow urine (100% V/V) were tested for their efficacy on *P. marginatus* in the laboratory. These bio-rationales were applied by using hand sprayer on the *P. marginatus* infested fruits. Mortality percentage of *P. marginatus* was assessed after 0.5 h, 3 h, 6 h, 24 h and 48 h of exposure. The experiment was carried out at a temperature of 28±1°C and 75% Relative humidity. The experiment followed a complete randomized design (CRD) with four replicates for each treatment. Giving 87.9%, 83.3%, 75.8% mortality of *P. marginatus* after 48 hours of exposure, Garlic bulb extract, *Pavetta* leaf extract and fermented cow urine were the most effective among the six bio-rationals. All six bio-rationals gave more than 50% control in 48 hours of exposure and provided eco-friendly management against *P. marginatus*. This information is useful to manage the papaw mealy bug using eco-friendly manner.

Key words: Bio-rationals, Garlic bulb extract, Papaw, *Paracoccus marginatus*, *Pavetta* leaf extract

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Egg parasitoids of *Trichoplusia ni: Trichogramma achaeae* Nagaraja and Nagarkatti 1969 and *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae) in Sri Lanka

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Diversity of trichogrammatid egg parasitoids has been poorly studied in Sri Lanka, and a total of ten species in seven genera have been recorded. These parasitoids are potential biocontrol agents to manage lepidopteran pests and widely used in some other countries. As an initial step of developing a bio-control programme for cabbage caterpillars, identification of naturally existing egg parasitoids was attempted in this study. The objective of this study was to identify the egg parasitoids associated with *T. ni* in cabbage growing areas in Kandy district. Two cabbage fields at Dodangolla and Thalatuoya were examined at weekly interval to collect *T. ni* eggs. Eggs were separated using a cork borer with a leaf piece and eggs were incubated in the laboratory until the emergence of adult parasitoids or the host larvae. Upon the emergence of adult parasitods, they were preserved in 70% ethanol. Subsequently, the parasitoid adults were dissected and slide mounted for further microscopic examination. Morphological structures of antennae, wings and genitalia were useful in identification as per the taxonomic keys. Identities were confirmed by Natural History Museum, London. Two species, *Trichogramma chilonis* Ishii and *Trichogramma achaeae* Nagaraja and Nagarkatti were found as egg parasitoids of *T. ni* in the study area. *T. achaeae* was found for the first time in Sri Lanka. *T. chilonis* had been found in a previous study parasitizing tea tortrix. *T. chilonis* was more prevalent than *T. achaeae.* Morphology of genitalia of both species was described comparing with the original species description.

Key words: Parasitoids, Trichogramma, *T. chilonis, T. achaeae*

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Identification of contaminants in tea (*camellia sinensis* L.) micro-propagation and standardizing the sterilization protocol

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Success of tea micro-propagation is hindered by severe microbial contamination of explants. This study aimed at developing an effective sterilization protocol by combining pre-harvesting sterilization measures with five different surface sterilization protocols using nodal explants taken from six new tea cultivars. Attempts were also made to identify the most abundant contaminants in tea and to incorporate fungicides to the culture medium in order to control them. Impact of pre harvesting sterilization measures (maintaining mother bushes inside a propagator with a fungicide spraying schedule) to reduce contaminations of nodal explants was inconsistent among accessions. Among the five surface sterilization techniques tested, treatment with 0.1% $HgCl_2$ for 10 minutes yielded the best results as it improved the number of clean and alive nodal explants (45.25 %). It was found that treatments with acidified bleach and bleach, ethanol and Tween 20 mixture were ineffective in reduction of contamination (>75%) and treatments with acidified bleach and benlate mixture where cuttings were kept overnight in a refrigerator resulted severe browning of explants (44.08%). Results revealed that two fungi *Pestalotiopsis* and *Aspergillus* were the most prominent contaminants found in tea stem nodal culture resulted 67.5% and 25% contaminations of explant respectively. When fungicides (Hexaconazole and Chlorothalonil) were added to the MS medium, high survival percentage of explants (>60%) were observed indicating possibility of replacing $HgCl_2$ after confirmation with further studies.

Key words: Fungicide added media, micro-propagation, nodal explants, pre-sterilization measures

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Formulation of value added crackers using defatted coconut flour and evaluation of its quality parameters

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The current food market shifts towards the development of healthy snacks. Crackers are popular as healthy snacks and a good source to enhance the nutritional value by incorporating natural ingredients. In the present study, dietary fiber content of the crackers was improved by incorporating defatted coconut flour (DCF) which is the whitish defatted kernel residue left in the virgin coconut oil (VCO) extraction process. Palm oil was replaced with VCO for cracker preparation. The chemical and functional properties of DCF and all-purpose wheat flour (WF) were studied. Crackers were prepared by incorporating DCF into WF at 10, 20, 30, 40% (w/w). Sensory evaluation was conducted using a 5-point hedonic scale with 21 panellists evaluating the crackers based on color, crispiness, texture, taste and overall acceptability. Physico-chemical characteristics and shelf life of the samples were evaluated after packing in triple laminated Aluminum foil and stored under ambient conditions. DCF was characterized with significantly higher crude fiber (17.69%), protein (22.10%) and mineral content (6.17%) than WF. The water holding capacity, bulk density and oil holding capacities of DCF were significantly higher than WF ($p<0.05$). Based on sensory results crackers produced with up to the level of 30% DCF were selected for further analysis. All the prepared crackers had significantly higher ($p<0.05$) protein, mineral and fiber contents compared to the control (100% WF). As the concentration of DCF was increased, spread ratio and weight of the crackers increased while thickness and puffiness of the crackers were decreased. Although cracker samples showed good acceptability at the beginning, their keeping quality decreased with the increasing level of defatted coconut flour. The results revealed that up to 20% (w/w) DCF can be incorporated in formulation crackers without compromising the physico-chemical and sensory attributes. The outcome of this study demonstrates the potential for industrial exploitation of DCF through processing into healthy snack food items such as crackers.

Key words: Crackers, defatted coconut flour, dietary fiber, spread ratio virgin coconut oil

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Impact of locally available organic amendments with leaching on pH in a saline soil

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A leaching column study was conducted at the Eastern University, Sri Lanka to study the impact of locally available organic amendments with leaching on pH in a saline soil. Farmyard manure (FYM), Gliricidia (G), partially burnt paddy husk (PBPH) and tank silt (TS) were used as soil amendments with leaching. All amendments were applied alone; FYM (T1), PBPH (T2), G (T3) and TS (T4) and as a combination farmyard manure with other amendments; FYM+PBPH (T1+ ½T2), FYM+G (T1+ ½T3), and FYM+TS (T1+ ½T4) at the rate of recommendation (T1-22, T2-0.625, T3-3.5, T4-100 Tons/ha). These eight treatments including the control (simple leaching without amendments) were replicated three times in a complete randomized design. The amendments were added to sandy loam saline soil from paddy land in Vaharai D.S. division, Batticaloa having an electrical conductivity (EC) and soil pH 13.1dSm−1 and 7.8 respectively. Saline soils mixed with treatments were filled into each leaching column (5.4 cm diameter and 30cm height), and incubated at room temperature for three weeks. After incubation, columns were filled with distilled water up to their saturation point. Then once in two weeks 150 ml of distilled water was added to each leaching column and the leachate was collected. Altogether four leaching cycles were completed during the study period. pH was measured in each leachate and in soil after the completion of leaching cycles. There was an increase in pH from 1st to 4th stage of leaching. At the final stage of leaching, the pH of leachate was significantly higher in control than other treatments. This shows most of the base salts in organically amended soil were washed at the time of the 3rd leaching while salts remains in control. Significantly least amount of pH was observed in the soil amended with FYM. In the soil analysis, significantly highest pH was recorded in control and significantly least pH was recorded in the tank silt.

Key words: pH, Organic Amendments, Saline soil

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Performance of broiler chicken fed diets containing different inclusion levels of turmeric (*Curcuma longa* L.) rhizome powder as a feed additive

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An experiment was conducted to study the efficiency of turmeric dietary rhizome powder on performance of broilers at different inclusion levels. Basal diet was supplemented with turmeric (*Curcuma longa* L.) at three different levels: 1g/kg feed, 2g/kg feed and 3g/kg feed with a control treatment. Thirty unisexed broiler chicks of Cobb strain at 21 days old were randomly allocated to each replicate of different treatments, and each treatment was replicated thrice. Each test diet was fed *ad-libitum* from 21st to 44th day. Total feed intake, weight gain per bird, feed conversion ratio, live weight at 45th day, carcass weight and dressing percent were the parameters determined. Data was analyzed using Statistical Analysis Software (Version 9.0). The results revealed that the significant difference ($P<0.05$) among differently treated broiler flocks was observed for total feed intake, weight gain, live weight at 45th day, carcass weight dressing percent and mortality. Further, the statistical analysis also revealed that the weight gain per bird (1483.0±22.1g), live weight (2425.0±45.4g) and carcass weight (1990.0±38.4g) were significantly higher ($P<0.05$) in broiler flocks treated with turmeric at 3g/kg feed. Feed intake also significantly lower in flock treated with reduced turmeric at 3g/kg feed. The dressing percent (86.4±1.7) was significantly higher ($P<0.05$) when the birds were fed with turmeric in 2g/kg feed. From the study, it was concluded that the turmeric rhizome powder at the rate of 3g/kg feed would have the potential of increasing the performance of broilers in terms of some growth and yield traits. However, further research related to mechanism of the action of turmeric and its interaction with other factors of production is necessary.

Key words: Broiler, feed conversion efficiency, rhizome, turmeric

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In vitro screening of *Trichoderma* species against (*Fusarium oxysporum* f. sp. *cepae*) and (*Colletotrichum gloeosporioides*) on red onion in Jaffna

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Fungal diseases, basal rot (*Fusarium oxysporum* f. sp. *cepae)* and leaf twister (*Colletotrichum gloeosporioides*) are the main problem in red onion cultivation in Jaffna, Sri Lanka. Disease symptoms of leaf twister were identified as initial appearance of leaf curling, twisting, chlorosis and abnormal elongation of the pseudo stem and with time withering and decaying of whole leaf blades. Rotting of basal plates and appearance of white mycelium are unique to the basal rot disease. This research was carried out to provide biological alternate for harmful fungicides by using different species of *Trichoderma*. Different combinations of the pathogen and bio-agents such as *F. oxysporum* f. sp. *cepae* (Fo): *Trichoderma viride* (Tv) at 1:1, 1:2, 1:4, 4:1, and 1:0 as control were tested as treatments with five replicates. *F. oxysporum* f. sp. *Cepae* was also tested with *Trichoderma harzianum* with the same ratios. Similar experiment was also conducted for *C. gloeosporioides*.The results showed that *F. oxysporum* f. sp. *cepae*: *T. viride* (1:4), *F.* o*xysporum* f. sp. *cepae*: *T. harzianum* (1:4) and *C. gleosporioides*: *T. viride* (1:4) yielded growth inhibition of 89.72%, 88.36% and 92.52% compared with untreated control. Both species of *Trichoderma* controls *F. oxysporum* f. sp. *cepae* efficiently, where as *T. viridae* is the best to control the *C. gloeosporioides* than *T. harzianum*.

Keywords: Basal rot, onion leaf twister, red onion, *Trichoderma* spp.

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Physico-chemical and sensory properties of fat based edible spreads in Sri Lankan market

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Fat-based edible spreads mainly consist of dairy fat based edible spreads (butter and dairy fat spreads) and non-dairy fat based edible spreads (margarine and fat spreads). The present study mainly focused on benchmarking of fat based edible spreads using the sensory and physico-chemical analysis to evaluate consumer preference and position of quality of the fat based edible spreads. Twenty four commercial samples of fat based edible spreads were tested for physico-chemical and sensory properties. Sensory evaluation was done by using 15 trained panellists based on the 9-hedonic scale. Moisture content, slip Point, colour, water activity and solid fat content (N values) at 10 $^{\circ}$C, 20 $^{\circ}$C, 30 $^{\circ}$C, 35 $^{\circ}$C, 40 $^{\circ}$C were determined as physical properties, and fat content, free fatty acid content, salt content, peroxide value, and the fatty acid profile including saturated (SFA), mono-unsaturated (MUFA), poly-unsaturated (PUFA), tans fatty acids (TFA) were tested as chemical properties. Duncan's multiple range test (DMRT) was done for the mean score rating for sensory analysis and least Squares Means of General Linear Model was carried out for mean separation of physico-chemical analysis by using SAS 9.1.3, (1999) program. Sensory analysis of fat based edible spreads showed that the samples differed significantly ($\alpha \leq 0.05$). Non-dairy fat based edible spreads, except the margarine had good mean score in aroma, colour, appearance and spreadability but in the overall taste, buttery taste and saltiness are very high in salted butter than the other spreads. Moisture content varied from 14.65 to 46.27 %, slip point from 28.3 to 36.3°C, water activity from 0.692 to 0.973, red colour from 1.17 to 4.17 and yellow colour from 45.33 to 70.00 on tintometer scale. Total solid fat contents (N value) were also measured from 10 to 40 $^{\circ}$C. Fat content of the samples varied from 20.07% to 81.37 %, free fatty acid level from 0.18 to 0.79%, salt content from 0.01 to 2.20 % and peroxide value from 0.08 to 15.77 (meq/kg). According to fatty acid profiles analyzed, high saturated (SFA) and trans- (TFA) fat could occur in butter, margarine and dairy fat spreads. However, high mono-unsaturated (MUFA) and poly-unsaturated (PUFA) fat could be occurring in non-dairy fat based edible spreads.

Key words: fat based edible spreads, margarine, physico-chemical properties, sensory evaluation, Sri Lankan market

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Impregnation of ethylene scrubbers in paper made from banana fibre delays ripening of 'Ambul' banana

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The effect of biodegradable ethylene scrubbers on extending storage life by reducing ripening of 'Ambul' banana (*Musa acuminata*, 'Mysore' subgroup, AAB group) was investigated. Among many techniques to remove ethylene and delay banana ripening during freight and storage, few are economical and eco-friendly. This preliminary study examined the possibility of impregnating determined concentrations of ethylene scrubber substances, i.e. activated charcoal (AC), potassium permanganate (PPM) and titanium dioxide (TD), into paper board made of banana fibre, a natural resource underutilized in Sri Lanka. All paper types, pure and impregnated, showed varying degrees of ethylene absorption over the 21 days of gas analysis in the *in-vitro* study, among which, the best absorption was by the PPM paper (95% of initial ethylene reduced by day 21). Quality analysis, for banana fruits of the *in-vivo* study was conducted on days 4, 7 and 10 of ambient and cold storage at 13.5^{o}C and 80% RH. Bananas stored with AC paper showed delayed ripening until day 4, followed by accelerated ripening. Sensory analysis for the fruits stored with AC paper under cold room conditions revealed that consumer preference for their flesh colour, taste and overall acceptability was significantly higher (at α= 0.05) than that for the control bananas. In the sensory analysis for banana fruits stored with TD paper under ambient conditions, a significant preference (at α= 0.05) was observed only for the peel colour. The quality analysis of the banana stored at ambient temperature with TD paper showed no significant difference to that of the control banana (except for skin colour on day 7). Further studies are needed to be carried out to get a feasible conclusion.

Key words: Banana, delay, ethylene scrubbers, ripening fibre

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Evaluation of some traditional rice cultivars for salinity tolerance in a Yoshida solution

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Salt stress is a major constraint which limits rice production. In the present study, 20 traditional rice cultivars were studied for salinity tolerance at the seedling stage in a hydroponic system. The experiment was carried out according to the completely randomized block design with four replicates and 10 plants were included in each replicate. Dormancy broken, surface sterilized rice seeds were germinated in distilled water for three days. After three days germinated seeds were transferred to saline solution with electrical conductivity 6 dS/m which was prepared by adding NaCl to Yoshida solution. After three days, EC level was increased up to 12 dS/m in the Yoshida solution. Nutrient solution was renewed in two day interval. Seedlings were kept in the same conditions for 21 days. Green plant height, root length and survival percentage of seedlings were evaluated on the 21st day. Root dry weight and shoot dry weight were evaluated at the end of the experiment after keeping materials at 70 ^{o}C for 7 days. Data analysis was done using ANOVA with Statistical Analysis System and Duncan multiple range test. *Moddaikaruppan, Galpa wee, Heenati-309, Handiran, Heendikwee* and *Dena wee* scored more than 20% survival rate and the highest survival rate was recorded by *Moddaikaruppan* (45.56%). M*uthumanikkam,* and *Dikwee* totally died during the stress period. Significantly highest green plant height (9.81cm) and root length (2.38cm) at salinity stress were recorded by *Moddaikaruppan* (α=5%). There were correlations in between survival percentage and plant height (r =0.927, α=5%) as well as survival percentage and root length (r= 0.928, α= 5%). There were no correlations in between survival percentage, root dry weight and shoot dry weight. Among all the tested rice cultivars *Moddaikaruppan* was the best salinity tolerant rice cultivar at the seedling stage.

Key words: Salinity tolerance, traditional rice cultivars, Yoshida solution

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Development of a cinnamon flavoured butter

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Novel food products made from functionally valuable commodities have gained an increasing consumer demand recently. Cinnamon *(Cinnamomum verum*) has gained recognition as a health promoting agent with the proven properties of reducing cardiovascular diseases, blood glucose control, reducing body fat and reducing risk of colonic cancer. The health beneficial effects of cinnamon derive primarily from bioactive ingredients such as antioxidants, polyphenols and flavonoids. With the existence of those properties, the aim of the present study was to develop butter sample made from cream with addition of Cinnamon bark powder. Cream at 36% fat content was churned at 8, 10, 15 ^{o}C temperatures to select the suitable churning temperature. Sensory evaluation was done using a ranking test for overall quality of butter which was churned at different temperatures by panel of 20 tasters. The butter which was churned at 10 ^{o}C showed the highest acceptance. The fat, pH, acidity, moisture, total solids, solid-non-fat and free fatty acid value were analyzed after production of butter. The high fat content (85.30 ± 0.16%) with high total solid content (87.03 ± 0.15%) was yielded at 10 ^{o}C temperature. The four levels 1, 3, 5, and 7% (w/w) of cinnamon powder were added to the butter prepared at 10 ^{o}C. Sensory evaluation was done using a ranking test for overall quality of cinnamon added butter to a panel of 20 tasters. It was found that up to 5% (w/w) cinnamon powder can be incorporated in the formulation of butter without comprising the sensory attributes. Significantly ($p<0.05$) high solid-non-fat content (3.25 ± 0.45%) and fat content (82.37 ± 0.29%) were present in cinnamon powder added butter. The cinnamon powder added butter showed a low level of peroxide value than normal butter. The cinnamon powder added butter sample showed high total antioxidant value (35.9%). Cinnamon powder added butter will be a new trend in world because it can be placed as a functional food.

Key words: Butter, cinnamon, churning temperature, storage stability

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Effect of plant height on yield of traditional rice cultivars

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Hundred traditional rice cultivars were evaluated for their yield potential and agronomic characters at the field condition at Faculty of Agriculture, Mapalana. Experiment was conducted with four replicates according to the randomized complete block design. Plant height (cm), number of fertile tillers/plant, number of fertile spikelets/panicle were measured in an individual rice cultivar before harvesting and panicle weight (g), 100 grain weight (g) and yield/plant (g) were measured after harvesting. Grain yield was positively and significantly correlated ($\alpha = 0.01$) with plant height ($r = 0.278$). Come to a decision on what parameters the best cultivars must be selected, a classical compromise programming was applied. Classical compromise programming is a multi-criteria decision analysis technique used to identify the best compromise solution from a set of solutions by some measure of distance. Finally, a sensitivity analysis was carried out using path coefficients so that the role of each parameter on the selection of the yield can be understood. To understand the effect of plant height on the field suitability of rice cultivars, plant height parameter was not included into multi-criteria decision analysis. According to the relative distances, all the rice cultivars were categorized in to 10 groups. To understand the contribution of plant height in determining these different groups of traditional rice cultivars, average plant height of each group was calculated. It was found that there was no significant difference in plant height in these groups.

Key words: Field performances, path analysis, plant height, traditional rice, yield

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Complete Submergence tolerance of some traditional rice cultivars at seedling stage

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Submergence tolerance is an important trait where short term flash flooding damages rice. Due to the heterogeneity in flood-prone ecosystem, many different types of traditional rice cultivars are grown by the farmers. Present study was conducted to explore the submergence tolerance traditional rice cultivars in traditional rice collections in Sri Lanka. Twenty Sri Lankan traditional rice cultivars were screened for complete submergence tolerance at two week old seedling stage. Experiment was carried out according to the randomized complete block design with 4 replicates and 20 plants were included into each replicate. After the complete submergence stress, desubmerged plants were allowed to recover for 14 days at normal growth conditions. Data were collected on the number of survival plants, plant height before and after the submergence stress and plant height after the two week recovery period. Control experiment was also carried out parallel to treatment. Among tested rice cultivars 45% rice cultivars elongated during complete submergence period while 55 % of rice cultivars reduced their height compared to that of control plants during 14 day submerged period. Among evaluated 20 traditional rice cultivars, all the cultivars died after two week recovery period followed by 14 day completely submergence stress except rice cultivar *Sudu Wee*. It also recorded 51% survival rate. *Sudu Goda Wee* and *Dik Wee 328* recorded the highest gained plant height during submerged period. Only *Sudu Wee* which elongated (5.45 cm) during submergence stress was able to survive at submerged conditions at seedling stage. There was no significant correlation ($r = 0.16$, $\alpha=0.5$) between height gain during 14 day submergence stress and survival percentage of rice cultivars at seedling stage.

Key words: Seedling stage, submergence tolerance, traditional rice cultivars

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Screening of selected Sri Lankan rice varieties under non-phosphate fertilizer condition

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Phosphate deficiency tolerance (PDT) is one of the significant traits in improving rice varieties. The present study was conducted to screen traditional and improved rice varieties developed by Rice Research and Development Institute (RRDI), Batalagoda (Bg) for PDT under greenhouse and field conditions. In the first season at RRDI, Bathalagoda, 11 rice varieties with four replicates and in the second season at University of Peradeniya, 30 varieties with three replicates were screened. Two levels of phosphate concentrations, no phosphate application, P_0 (5 Kg/ha or less present in soil) and the application of recommended phosphate concentration, P_{30} (30 Kg/ha) were used. Eleven rice varieties in the first season and 20 varieties in the second season were screened for PDT in a field where no fertilizer has been applied for last 30 years at RRDI. Morphological data such as plant height was measured at every two weeks interval. All plants were harvested at flowering stage and number of tillers and shoot dry weight was taken at flowering stage for both green house and field grown plants. Soil (growth medium) was collected from each pot and from the field at flowering stage, soil available phosphorous was measured and plant phosphate content was measured. Out of the traits studied, the major trait to assess P-deficiency tolerance was the plant dry weight. From the screening results, all varieties can be grouped in to four classes as highly tolerant (HT), tolerant (T), sensitive (S) and highly sensitive (HS) to phosphate deficiency. Out of the all varieties studied, H4, MAS, Murungakayan and Sudu heenati were the highly tolerant varieties phosphate deficiency whereas Bg 352, Bg 357 and At 354 were the highly sensitive. After selecting the tolerant and sensitive varieties, crosses were made between highly sensitive and highly resistant varieties for further molecular analysis. At the end, attempts will be made to discover molecular markers linked with PDT to be used in the marker assisted selection in rice breeding.

Key words: Marker assisted selection, *Oryza sativa*, phosphate deficiency tolerance

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Evaluation of antibacterial efficacy of mangrove leaf extracts on fish bacterial pathogens

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Bacterial pathogens which affect aquatic animals and humans become resistant to antibiotics due to long term exposure. This study focused on the antibacterial efficacy of six species of mangroves (*Avicennia marina, Lumnitzera racemosa, Bruguiera sexangula, Acanthus ilicifolius, Rhizophora mucronata, Excoecaria agallocha*) against four pathogenic bacteria, *Pseudomonas fluorescens, P. aeruginosa, Shigella flexneri* and *Listeria monocytogenes.* Mangrove leaf extracts were obtained using 95% methanol as a solvent and the final compound was methanol free due to evaporation. All the extracts concentrations were made in to 350 mg/ml. Nutrient agar plates were used to culture bacteria and the diameter of inhibition zones were measured by well diffusion method after 24 hours incubation at 25°C. The results were compared with Tetracycline as the positive control and solvent without extract as a negative control. The highest inhibition zone (18.8 ± 1.04 mm) was observed in *R. mucronata* leaf extract against *L. Monocytogenes* while Tetracycline showed 22 mm of inhibition. All the other mangrove extracts were effective against all bacterial pathogens tested at a diameter of 17.4–12.5 mm while Tetracycline exhibited approximately 22 mm of inhibitions for all bacterial pathogens except for *S. flexneri. S. flexneri* was resistant against Tetracycline and moderately susceptible for all typed of mangrove extracts (7.4–12.3 mm). The tested mangrove leaf extracts were effective against aquatic bacterial pathogens used ($p<0.5$) *in vitro* and has a potential to develop as an environmentally friendly antibiotic.

Key words: Antibacterial resistance, bacterial pathogens, mangroves extracts

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Effect of microbial inoculation on tuber development of potato (*Solanum tuberosum* L.)

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Last two decades, there has been a general decline in the yields of major crops because of the collapse of beneficial soil microbial communities under conventional agricultural practices. Chemical inputs like fertilizers and agrochemicals have been responsible to this microbial depletion. Use of Plant Growth Promoting Rhizobacteria (PGPR) for the benefits of agriculture is gaining worldwide acceptance and appears to be the trend for the future. Inoculation of crop plants with certain strains of beneficial, free-living bacteria enhance emergence, colonize roots, stimulate growth and enhance yield. A study was conducted to evaluate the beneficial effect of fungal and bacterial monoculture inoculations on yield enhancement of potato under greenhouse conditions. Microbial isolations were done using the top loamy soil samples obtained from abandoned potato crop land in Agriculture Research Center, Bandarawela. The isolated microbial strains (PCM1, PCM4, PCM5, PCM8, PCMrg, PCMry, PCMrw and PCMB) were applied directly around the root zone of the potato plants grown in pots under the greenhouse conditions. Each pot contained three disease free potato seed tubers with sterilized sand medium. Effect of the microbial monocultures on the growth performance of the potato was measured using number of tuber initiation, dry weights of tubers, shoots and the roots. Potato plants without any microbial treatment were considered as the control experiment. The results of ANOVA revealed that all the bacterial monocultures except PCMrg and PCM4 significantly enhanced the tuber dry weight of potato ($p = 0.001$). Thus, it can be concluded that the bacterial isolations enhance the growth promotion through the development of tuber.

Key words: Microbial monocultures, plant growth promoting rhizobacteria (PGPR), potato

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The influence of nutrient availability on the growth and morphology of *Chromolaena odorata* (siam weed)

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Invasion success is more often influenced by the nutrient availability in the ecosystems. The growth and morphological responses of the invasive plant species, *Chromolaena odorata* (Siam weed; *Asteraceae*) was evaluated in three different nutrient conditions. The experimental conditions were addition of 1g (High) and 0.25g (Medium) of 20:20:20 N: P: K mixture per pot, once in a week and natural soil as the control without adding any nutrients. The experiment continued for 100 days with 6 replicates. Statistical analysis was done by using one way ANOVA method. At the end of the experiment period, high nutrient condition significantly ($P>0.05$) increased the biomass content of the plant (shoot and root dry mass, relative growth rate, specific root length). High nutrient treatment increased relative growth rate more than 73% compared to the control. In general, nutrient addition significantly increased the biomass content of a plant. We hypothesize that invasion and domination of *C. odorata* can be suppressed by minimizing nutrients accumulation in invaded ecosystem as one control mechanism.

Key words: Biomass allocation, *Chromolaenaodorata*, growth, invasion success

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Variation of microbial community along a chronosequence of age in *Eucalyptus grandis* forest plantation and some other land uses in the intermediate zone of Sri Lanka

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Population variation of fungi and bacteria in different aged *Eucalyptus grandis* plantation forest soil was studied. Plantations aged 7, 13, 22 and 30 years and adjacent tea estate, abandon *Eucalyptus* planted site (without plants) and natural forest were selected as study sites from Passara, Uva Province area. Necessary parameters were considered to minimize microclimatic variations among the field sites. Soils were collected using a soil auger cleaned with 90 % alcohol from top layer (0-15 cm layer). The soil extractions were prepared in dilution series and cultured using Potato dextrose agar and nutrient agar and microbial count was taken. *Eucalyptus* plantations showed lower amount of fungal populations compared to other sites. The 30 years old *Eucalyptus* plantation had the highest amount of fungal population (953±122 MPN g^{-1}) compared to other *Eucalyptus* plantations. There were significant relationship between fungal population and stand age of *Eucalyptus* plantation ($p<0.0001$; R^2 = 98.44 %). But the stand age is not significantly affected to bacterial population ($p > 0.05$). So mainly because of fungal population, fungi to bacteria ratio (F: B) in soil varied with plantation's stand age. The low F : B indicated that *Eucalyptus* plantation forests are bacteria dominant. This study suggest that fungal population is more sensitive than bacterial population to the stand age related factors in soil such as nutrient content and understory, which could be important in sustainable management and restoration of *Eucalyptus* plantation soils for a better yield.

Key words: Bacteria, *Eucalyptus* plantations, fungi, stand age

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Breaking the seed dormancy in *Phylanthus emblica* L. (V. Nelli)

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Phyllanthus emblica V. Nelli, belonged to family Euphorbiaceae, is an important species as a medicinal plant. The fruit (drupe) of *P. emblica* is the economically important component. It is also being used in industrial processes such as synthesis of ayurvedic drugs and manufacturing of fruit juices. When establishing breeding programs or orchards of *P. emblica*, seed germination is a huge problem because seeds of *P. emblica* have a long dormancy period and show very low rates of germination. This is greatly contributing to remain it as an underutilized fruit crop because of the lack of quality planting material. According to our knowledge, no detailed studies have been carried out to study the seed dormancy of *P. emblica* and a method to break the dormancy, although it is being identified as a prime requirement to uplift this crop from its underutilized status. Thus the objective of this study was to identify a method to overturn the seed dormancy of *P. emblica*. The seeds were extracted from mature drupes. The selected viable seeds were subjected to four pre-treatment's; no pre-treatment, seed scarification, seed scarification and pre-treatment with 1% gibberellin and seed coat removal and pre-treatment with 1% gibberellin. The seed dormancy was only overturned with a germination percentage of 43% by the seed pre-treatment, seed scarification and pre-treatment with 1% gibbberellin (after 85 days of pre-treatment) and no other pre-treatment methods were able to break the dormancy of any seeds. Therefore, it can be concluded that seed coat scarification and gibberellin pre-treatment can be used to obtain increased germination of *P. emblica* seeds in conducting breeding programs and establishing orchards for drupe production at commercial scale.

Key words: Gibberellin, *Phyllanthus emblica*, Seed dormancy, Seed scarification

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Preliminary results of activity guided fractionation of the ethnolic extract of dried flowers of *Aegle marmelos* (belimal)

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Activity guided fractionation of ethanolic extract of dried flowers of *Aegle marmelos*, based on the anti-inflammatory effect was studied in the present study. The ethanolic extract of the flowers was partitioned into ethyl acetate and hexane, and the fractions were tested for anti-inflammatory effect using carrageenan-induced paw oedema rat model. The ethyl acetate fraction was separated into fraction 1, 2, 3, and 4 by column chromatography with Sephadex G_{25} and tested for anti-inflammatory activity. Fraction 1 was fractionated by silica column using ethyl acetate: dichlromethane (100:0 to 0:100) solvent system and obtained fractions a, b and c. They were tested for anti-inflammatory activity. Fraction a, was separated into band 1, 2 and 3 by preparative TLC with hexane: ethyl acetate (1:9) and tested for anti-inflammatory effect. Phytochemical screening was done on fractions and the FTIR and NMR spectra of band 3 were taken. The maximum percentage inhibition of paw oedema (MPIPO) of ethyl acetate fraction and hexane fraction were 82.7% and 66.1%, respectively. The MPIPO of fractions 1, 2, 3, and 4 were 86.7%, 72.3%, 75.9%, and 67.3% respectively. The MPIPO of fractions a, b and c were 67.4%, 36.3%, and 53.1% respectively. The MPIPO of bands 1, 2, and 3 were 45.5%, 30.9% and 53.9% respectively.The FTIR spectrum exhibited the presence of O-H/N-H/C=O/C-Cl and C=C groups in band 3 and the NMR readings suggested that the band 3 is required to be purified further. Phytochemical screening revealed the presence of poly phenols and triterpenoids in band 3and they may be the compounds that responsible for the anti-inflammatory effect of *belimal*.

Key Words: *Aegle marmelos*, anti-inflammatory activity, ethanol extract, fractionation

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Assessing the efficacy of some commercially available disinfectants and antiseptics

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Disinfectants and antiseptics are chemical agents that are used to control microorganisms. The objectives of this study were to assess the efficacy of some selected disinfectants/antiseptics at the manufacturer-recommended dilution (MRD) and to compare the efficacy of each product at serial concentrations of MRD. Commercially available disinfectants/antiseptics containing benzalkonium chloride (A), sodium hypochlorite (B), chlorinated phenol (C) and phenol (D), were used in this study. Sterile filter-paper discs were dipped separately in different concentrations of each product ranging from the MRD to its serial concentrations. The discs were then incubated on agar plates pre-spreaded with *Staphylococcus aureus* cultures. Mean diameters of inhibitory zones (ZI) were measured and statistically analyzed for differences with different products. The efficacy of each disinfectant/antiseptic was assessed according to (ZI). Product D showed the highest efficacy whereas product A showed the least efficacy at the MRD. There was no difference in the efficacy of MRD, and its two-fold increase, with product A. In contrast, products B and C showed an increase in the efficacy ($p<0.01$) with each two-fold increase in the product concentration starting from the MRD. With reference to product D, no difference was observed with the efficacy of MRD and its two-fold increase. Further increase of product concentration (from two-fold to four-fold) showed a decrease in efficacy ($p<0.01$). In conclusion, all disinfectant/antiseptic products of this study were effective at the MRD. However, the degree of efficacy was different ($p<0.01$) among products. Certain products (A & D) showed no increase in efficacy ($p>0.01$) at two-fold increase of MRD but showed increase in the efficacy ($p<0.01$) at higher concentrations.

Key words: Antiseptics, disinfectants, efficacy, manufacturer-recommended dilution

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Treatment of highly coloured textile dyeing waste water by Fenton and photo Fenton processes

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As textile industry in Sri Lanka generates large quantities of highly coloured wastewater from various steps of dyeing processes, there is a pressing need for an efficient waste water treatment method for the decolouration of effluents before discharging them into inland water bodies. Treatment of textile dyeing waste water using biological methods is not possible as the BOD_5/COD ratio is low (0.15). Advanced oxidation processes are potentially feasible options for treatment of these wastewaters. In the present study, the treatment of textile dyeing wastewater was performed using Fenton's oxidation process. Fenton's process under acidic conditions, a Fe^{2+}/H_2O_2 mixture produces hydroxyl radicals in a very cost-effective manner. The raw waste water and waste water treated by conventional treatments (coagulation) were tested to find the optimum reaction conditions. Photo Fenton's process was performed under strong Sunlight conditions for 2-3 hours. The raw wastewater treated by Fenton's process exhibited COD and colour removal of 77 % and ~99 %, respectively. Using Fenton's oxidation as a post-treatment method for the treated textile waste water by conventional methods resulted COD and colour removal efficiencies of 78 % and ~99 %, respectively. The raw wastewater treated by Photo Fenton's process exhibited COD and colour removal of 81 % and ~99 %, respectively. Using Photo Fenton's oxidation as a post-treatment method for the treated textile waste water by conventional methods resulted COD and colour removal efficiencies of 88 % and ~99 %, respectively. The maximum colour removal and COD reduction were observed at a Fe^{2+} dose of 0.17 g/L and H_2O_2 dose of 1.0 g/L.

Key words: COD, Fenton oxidation, waste treatment,

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Fitting distribution to the extreme rainfall in Galle, Sri Lanka

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The occurrence of high magnitude rainfall results in primary natural hazards in Galle, Sri Lanka. Therefore, a study on the estimation of extreme rainfall for various return periods is important form the point of view of risk management. This paper presents a good fitting distribution to daily rainfall occurred during years 1951-2012 in Galle region. Two approaches, Annual Maxima (AM) approach for the annual maximum rainfall, and Peak Over Threshold (POT) approach for the entire rainfall and the seasonal rainfall; North-East, First inter monsoon, South-East and Second inter monsoon periods have been considered for the analysis. The families of Generalized Extreme Value (GEV) and Generalized Pareto distributions (GPD) were used to perform the Extreme Value analysis and Maximum Likelihood Estimation (MLE) method was used to estimate parameters. It has been shown that the Gumbel distribution fits well with the Annual Maximum rainfall. For the entire rainfall and the seasonal rainfall, different threshold values were identified as 64, 22, 27, 50 and 38, respectively. Exponential distribution fits well with the rainfall over the specified different threshold values for the entire data and seasonal data. This study also predicts the return level and their confidence band for 2, 5, 10, 20, 50, 100 and 200 years using the identified distributions.

Key words: Annual maximum, Generalized Extreme Value distribution, maximum Likelihood Estimation, Pareto distribution, threshold value

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A low cost electronically controlled multi function dryer

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A simple automated device has been designed and constructed to dehydrate different types of food for industrial applications. Preliminary tests indicated that the device could dehydrate a food under a desired temperature. The dehydrating temperature range and processing time could be adjusted to a predetermined value to match the characteristics of food. Another important feature of this device is that it could be coupled to any source of heat (ex. firewood, dry rot, electricity, LP gas etc.). This device could be modified to use for many applications in domestic and large-scale industries. Indicators in the controlling panel displays the status of the dehydration process and a buzzer attached to the device makes a warning sound to remove the dehydrated materials from the dryer at the end of the process. The device has been designed in a user friendly manner and the automated controlling system helps to save operator's time as no monitoring is needed during processing. The main advantage is that the device can be easily manufactured locally at low cost.

Key words: automated, dehydration, processing time and dryer

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Use of TiO_2 as electrochromic material with Chitosan gel polymer electrolyte in low cost electrochromic smart windows

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Since most of the efficient electrochromic devices (ECDs) consist of expensive rare earth materials such as Tungsten (VI) oxide, (WO_3) and Cerium (IV) oxide, (CeO_2) and liquid electrolytes comprising with volatile solvents such as acetonitrile, there exist some significant technological problems associated with the fabrication cost and the encapsulation of these devices. Therefore, there is a considerable interest in both the development of a solid or quasi solid electrolyte and replacement of these expensive materials with possible low cost alternatives. By considering these facts, we have explored the possibility of use of natural polymer, Chitosan (Poly D-glucosamine) containing Li^+ ions as the quasi solid polymer electrolyte and at the same time replacement of expensive WO_3 and CeO_2 with low cost Titanium dioxide (TiO_2) and Tin oxide (SnO_2) respectively as alternatives. The EC devices with dimensions, 2.1x1.4 cm^2 with configuration FTO glass/TiO_2/Chitosan polymer electrolyte /SnO_2/FTO were fabricated. Temperature dependence of DC conductivity of the polymer electrolyte, containing either $LiClO_4$ or $LiCF_3SO_3$ salts, was measured with varying the salt concentration. The best room temperature ionic conductivities found are in the order of $5.17x10^{-2}$ S cm^{-1} and 4.09 x 10^{-2} S cm^{-1} with corresponding lithium concentration 0.5M and 1M for $LiClO_4$ and $LiCF_3SO_3$ respectively. Electrochemical and optical properties of the electrolyte and ECDs were measured by cyclic voltammetry and UV-visible spectroscopy. The average transmittance in the visible region of the spectrum is about 58% at the bleached state and below 15% at the colored state for all the samples studied.

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Preliminary results of noise level measurements inside passenger buses in southern province of Sri Lanka

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Commuters who use public buses including luxury ones to travel long distances often complain loud noise as a major disturbance to their journey. This study presents preliminary results of measurements of noise level distribution inside passenger busses operated in southern province of Sri Lanka. According to WHO guidelines, prolonged exposure to high levels of noise (>70 dB(A)) could cause physical and psychological problems and exposure to noise levels greater than 85 dB(A) could result in hearing loss. Diffuse field noise measurements in 104 randomly selected buses were taken using a B&K Type-2250 hand held analyzer. Several noise descriptors including L_{Aeq}, L_{Cpeak} and L_{AFmax} were measured in front, middle and back of fully seated buses.L_{Aeq} values of all buses in the sample were found to be greater than 70 dB(A) with audio system turned on. Noise levels were found to be greater than 75, 80 and 85 dB(A) in about 80%, 42% and 10% of the buses, respectively. The contribution from the audio system to the background noise level inside buses was found to be about 5-10 dB(A). L_{Cpeak} values about 110 dB(A) levels have been measured which were mostly due to modified horns of buses. The noise is found to be predominantly generated by acoustic waves of frequencies in the range 12 to 200 Hz and such low frequency noise is known to cause more health problems than noise due to high frequency sound waves. This study suggests the necessity of introducing noise monitoring and regulatory systems for busses, especially, for audio systems and horns, and conducting awareness programs for bus operators.

Key words: Audio system, noise descriptor, passenger buses, noise level

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Design and construction of a temperature monitoring system for a noodles dryer at a local industry

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The drying process of noodles made at a local industry in Matara, was studied with the aim of making improvements to the machine used and the process followed. Frequent oven opening to check the quality and consistency of the drying product is an unnecessary intervention which leads to waste of electric power. A comprehensive study of the noodles drying process was undertaken to search for possible methods to increase the efficiency of the production. It was found that a systematic monitoring of temperature during the drying process and a measurement of time taken for the completion of the process were required to make some improvements. Thus, a digital electronic temperature monitoring system with an adjustable timer was developed to increase the efficiency of the drying process. The designed equipment included a keypad, a LM 35 temperature sensor and a PIC16F877A microcontroller. The temperature sensed is converted to an analog electrical signal and sent to the microcontroller. The analog signal is converted to a digital signal and transmitted to the SSD (Seven Segment Display) unit. The time left for the completion of the drying process and the temperature inside the oven at any moment are displayed on SSD. When the time exceeded a preset value, a buzzer was activated automatically to draw the attention of the workers to remove the dried product. An attractive display system was accomplished at a minimal cost.

Key words: Temperature sensor, Microcontroller, SSD

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Photoelectrochemical characteristics of p-Cu_2O prepared by an easy fabrication method

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P-type Cu_2O nano-surfaces were obtained by heating well cleaned, commercially available copper plates (98.9% purity and 2cm x 4cm in size). Initially, a heating rate of $100^oC\ min^{-1}$ was provided with copper sheets inside the furnace, starting from the room temperature, until the temperature reached 500^oC, and then the temperature was kept constant for 30 minutes and allowed to cool back to room temperature. Three-electrode configuration was used to measure the generated photocurrent. I-V characteristics of the sample were investigated by using the sample as a photocathode in a Photo Electro Chemical (PEC) solar cell. From the investigation of I-V characteristics and optical absorption properties, a remarkable stability of the sample was observed. This observation was supported by the experimental data of XRD, FTIR and AFM surface analysis.

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Design and construction of a display system for systematic monitoring of the noodles steaming process at a local industry

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The study was done at a prominent consumer goods manufacturing company in the southern province of Sri Lanka. Noodles are one of their products of high demand. Therefore, the company needed a systematic and comprehensive monitoring system for the noodles steaming process to enhance its efficiency. An embedded temperature acquisition system was designed for the steaming cupboard. The temperature acquisition is made with a temperature sensor and a microcontroller. The control panel includes a synchronizing temperature display with time, buzzer and a time setting buttons (keypad). The SSDs (Seven Segment Display) are used to display the temperature and time. The buzzer is used to signal the completion of the set time. Temperature is sensed using an analog sensor and ADC (Analog to Digital Convertor) of microcontroller is used for the acquisition. Temperature output is displayed digitally in SSDs using a high-level programming language.

Key words: Microcontroller's Analog to Digital Convertor, Temperature sensor, SSD

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Characteristics of n-Cu_2O/p-CuI junction photo-electrode in relation to solar energy conversion devices

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n-Cu_2O/p-CuI junction photo-electrode was fabricated on copper sheets to make a solid state photo-voltaic cell. A photo current enhancement was found for the junction photo-electrode because of the efficient charge separation process operated at the junction compared to that of the solar cells fabricated from bare semiconductor thin films. Mainly the photo-current generation was found due to the band to band transitions of n-Cu_2O films in the junction photo-electrode. AFM, XRD and optical absorption properties of the materials were studied to explain the photo-current generation of the solar cell. It was found that the sample was highly stable with time under illumination of light. Power conversion efficiency reached is nearly 2.4% for n-Cu_2O/p-CuI junction photo-electrode.

Key words: n-Cu_2O, p-CuI, solid state photovoltaic cell

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Design and construction of an automated rain gauge

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An "Automated Rain Gauge" has been designed and constructed successfully using a microcontroller. The method is based on measuring the mass of rain water using a load cell. The rainfall is measured and recorded automatically and recorded data displayed hourly by an LCD (liquid crystal display) attached to the rain gauge. A green light is displayed at moderate rainfall levels. If the rainfall exceeds a pre-determined threshold level, a red light will be displayed with a warning alarm. The rain gauge shows a good linear relation of rainfall to the mass of water collected on the load cell. The accuracy could be improved further using a more sensitive load cell. One main feature of the rain gauge is a warning to be given automatically if the rainfall exceeds a predetermined value.

Key words: Automatic rain gauge, LCD display, Load cell, Microcontroller

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Semilinear delay evolution equations with nonlinear constraints

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This paper deals with semilinear delay evolution equations with nonlinear constraints. To find an integral solution to this problem, semilinear delay evolution equation with nonlinear constraints is converted into the abstract functional differential equation with non-densely defined generators and solved as an inhomogeneous cauchy problem. Since non-densely defined generators are used, it is possible to use integrated semigroup approach to solve this problem. Age structured proliferating cell population with inherited cycle length, including delay terms, is modeled as a semilinear delay evolution equation with nonlinear constraints and obtained an integral solution for this model by using the above method.

Key words: Cycle length, integrated semigroups, proliferating cell population

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Weighted bipartite matching and the Hungarian method

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The Assignment Problem, a major problem in combinatorial optimization, can be related to graph theory as finding an optimal weight matching in a weighted bipartite graph. We have considered the Hungarian algorithm which was found by Harold W. Kuhn in 1955. The algorithm is to find a maximum (minimum) weight perfect matching, in polynomial time. It replaces the original graph with a weighted covering and converts the problem into finding a weighted covering with a perfect matching. Starting with an arbitrary matching, it progresses in iterations such that in the i^{th} iteration to find a matching of size i with maximum weight. This is a better way to solve the assignment problem; Sometimes there may be a better solution than the algorithm returns. Because the algorithm always returns a perfect matching, but a graph with large number of vertices, one can neglect some edges with small weights to obtain a better maximum weight matching without the perfectiveness.

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Intrusion detection of web sites with data mining techniques – A survey

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Growth of computer intrusions highlights the incontestable importance of intrusion detection. Most common attacks on web sites are cross site scripting (XSS), SQL injection, denial of service (DoS) and session hijacking. As the usage of computer networks increased dramatically, networked computers are exposed to intrusions such as unauthorized access, bandwidth theft and DoS than ever before. Intrusion detection systems employ traditional signature based methods or data mining based methods as the basic technique of detecting intrusions. In this paper, we primarily focus on data mining based method, more specifically, anomaly detection. The usage of data mining functions such as preprocessing, association rule mining, classification and clustering in the domain of anomaly detection of web sites are discussed. Several data preparation techniques can be used to improve the performance of analysis and this process is known as preprocessing. Labeled preprocessed log data are taken to recognize classes and to generate rule associations from the frequent patterns. Importantly, previously unknown intrusions are detected by clustering. It is observed that clustering based anomaly detection techniques rely on an assumption which differentiate anomalies from normal data. As the output of our survey, comprehensive intrusion detection system for a web site was modeled. The proposed system employs several agents namely, data collector, preprocessor and detector.

Key words: Anomaly Detection, intrusion, intrusion Detection Systems, data Mining

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Automation of multiple data measurements for computer interface

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Development of low cost instrumentation is a valuable exercise in a country like Sri Lanka where scientists strive to sustain in their research with limited funds. This student research project is motivated on such grounds and integrated with the existing experimental facility developed locally. In this work, a multiplexing electronic device was designed and constructed to automate multiple measurements of several samples during slow cooling-heating runs and isothermal measurements of an applied magnetic field sweep. The self-designed low-cost multiplexing device is constructed to automatically select one from several input signals and be measured either by an instrument or by microprocessor via analogue to digital converter. The device can be used with an amplification option if the resolution of the measuring instrument is insufficient. The design was with a multiplexer IC 4051 to automatically select inputs at specific time intervals that is controlled by 4017 Counter IC supported by 555 Timer IC, while the selected channel inputs are identified via a seven segment display. Op-amp CA 3140 was used for the amplification option. A specially designed regulated power supply unit provides the dc power requirements for the device. Microprocessor was connected using flash analog to digital converting method. Visual Studio 2007 software and the C++ programming were used to accept and analyze the digital data from the multiplexing electronic device. Several test experiments were performed to ascertain the multiplexing process and to validate the amplification reliability. The uncertainty that arises due to amplification is verified to be within 6%.

Key words: Automation, instrumentation, multiplexer

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Towards a simple and secure electronic tender submission management protocol

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The traditional tendering process is a manual bidding system which involves the principal advertising or issuing a request for tenders, various suppliers then make offers, one of which is then accepted by the principal, forming a contract between the supplier and the principal. Electronic tender (eTender) management is the continuous usage of electronic means for the entire tendering process. It enables suppliers in different geographic locations to be notified of an opportunity to express an interest to download tender documents and to submit a response. This promotes competition for the tender and a selection process that is transparent to bidders. eTender solutions are developed in the absence of the ability to authenticate people by sight. This creates problems with authenticity and integrity of electronic transactions as trust has been compromised. Improper use of electronic communication systems could also increase the possibility of leaking of tender information. Hence security mechanisms were carefully integrated into the system to provide desirable security services for the processes involved in an eTender management system. The focus of this research is to develop a simple security protocol for electronic tender management that confirms it met the security challenges such as authenticity, integrity, confidentiality and non-repudiation, faced by such systems. It comprised of developing methodologies for establishing security requirements, constructing security protocols and security verification with a user friendly interface. A security protocol was developed using generic symmetric key cryptographic mechanisms with a random string as an additional security measure. The validity of the protocol was tested progressively throughout the design and development process to confirm that it provides sufficient security measures against the challenges. In addition, it was also tested against identified risk scenarios.

Key words: Cryptography, etender, protocol, security

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Age invariant face recognition: A survey

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Facial aging is an important yet challenging problem that has recently been added to the problem of the face recognition. Human face varies over time in many aspects, including large inter-user similarity such as facial texture wrinkles, shape weight gain, facial hair, presence of glasses, etc. and large intra-subject variations such as pose, illumination, expression, and aging. Age invariant face recognition recently has gained a significant interest within the image processing and computer vision research community because of its explosively emerging real-world applications in many areas, such as forensic art, electronic customer relationship management, security control and surveillance monitoring, biometrics, entertainment, and cosmetology. This paper presents a thorough analysis on the problem of facial aging and further provides a complete account of the many interesting studies that have been performed on this topic. The face recognition methods that overcome aging fall into two main categories: generative and non-generative. Here we discuss a detail analysis of above two approaches that have been proposed for this problem and offer insights into future research on this topic. However, designing an appropriate feature representation and an effective matching framework for age invariant face recognition remains an open problem as no reliable and high performing research result is reportedly implemented. Investigation results related to various illumination conditions, different expressions, biometric performance issues, etc are not satisfactory or not available at all.

Key words: Age invariant face recognition, craniofacial growth, facial feature drifts, generative approach, non-generative approach

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Analysis of protein interactions of pre-eclampsia

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Pre-eclampsia is a pregnancy complication caused by high-blood pressure and protein in the urine in pregnancy. This disease can affect both the mother and the fetus and increase the mother's risk of dying of cardiovascular disease. This can be seen among the Sri Lankan women and it is a major pregnancy problem of them. Several researchers have found several types of genes that involve cause of pre-eclampsia in humans. It is proved that this cannot be seen in other organisms and it was further analyzed by a group of Sri Lankan researchers. According to previous studies, the major family of genes was Epidermal Growth Factor receptor and its associated genes. These genes include EGF, TGFA, AR, HB-EGF, Epigen, BTC and EPR. However, recently more genes excluding EGFR family were detected such as SIAE, a genetic variant of AGT2R and HLA-DQB1. There are several interactions exist between proteins (protein-protein/ ligand-receptor) that affect pre-eclampsia. The objective of this research is to analyze the genes and their protein-protein interaction networks that have been proved or suspected as a cause for pre-eclampsia.

Key words: Pre-eclampsia, protein-protein Interactions

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An agent based simulation for the shape adaption of 'Coccus' type bacteria colonies

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Agent technology is one of the Artificial Intelligence techniques best suited to address a social or biological phenomenon which involves group dynamics. Moreover, computer simulations are used extensively for studying artificial intelligence applications. Hence, research paper presents a simulator that will be helpful for the researchers in medical laboratories and students in Biochemistry and Molecular Biology to find the shapes in bacterial colonies for their findings. This research focuses on applying the behavior of swarm of agents that interact upon each other to achieve a common goal for bacteria colony shape adaption for Coccus type. The research emerged a computer simulator using the *Pediococcus acidilactici* species as the sample. The simulator formed a circular shape as the final shape of the colony which is comparable with the laboratory results of given species. The resulted simulator which is developed using NetLogo agent simulation toolkit represents each bacterium as a programmable agent. Simulator allows bacteria to communicate with each other through environment which acts as the message agent to form the ultimate shape of the colony.

Keywords: Agent Technology, colony shapes, simulations

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