8TH SYMPOSIUM
of the B.Sc.(Hons) Degree
in Applied Sciences

UNI-IN ALLIANCE 2022

"Inspiring young researchers for reviving Sri Lankan economy"

Proceedings of
Uni-In Alliance Symposium

Proceedings of the
8th Undergraduate Symposium
"UNI-IN ALLIANCE 2022"

Faculty of Applied Sciences

University of Sri Jayewardenepura, Nugegoda, Sri Lanka

14th of October 2022

Organized by

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14th of October 2022

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B.Sc. (Honours) Degree in Applied Sciences

Faculty of Applied Sciences

University of Sri Jayewardenepura

Gangodawila, Nugegoda, Sri Lanka

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Message from Senior Prof. Sudantha Liyanage

Vice Chancellor

University of Sri Jayewardenepura

It is with great delight that I am writing this message for the 8th Uni-In Alliance Symposium 2022, organized by the students in the B.Sc. (Honours) degree program in Applied Sciences under a very topical theme, "Inspiring young researchers for reviving Sri Lankan economy". I had the pleasure of seeing the development and success of this symposium during my tenure as the Dean of the Faculty of Applied Sciences of the University of Sri Jayewardenepura. I am thrilled to observe the significant impact this symposium has had on the study population and the field of Applied Sciences.

As Sri Lankans, we are currently confronting several issues, primarily due to Sri Lanka's unstable economy. As a result of these numerous issues, it can be observed that Sri Lankans have come up with innovative solutions. Young researchers, in particular, tend to develop novel answers to the issues they are currently dealing with. However, because of the uncertain economy, none of these alternatives has received adequate backing and support to reach industrial level. Therefore, this symposium will serve as a great forum for connecting business and academia to resolve current issues, which will consequently aid in the growth of the nation's economy.

The B.Sc. (Honours) in Applied Sciences degree program is exceptional as it offers a forum for knowledge sharing and discussion beyond scientific research and instruction. It creates a great opportunity for the students looking forward to obtaining industrial exposure before they step into their respective careers. Furthermore, this degree program bridges the gap between academia and the industry. Hence, the students can experience practical applications in the industry during their undergraduate program.

I wish to express my sincere gratitude to the organizers for bridging the gap between the industry and the University through this symposium. Furthermore, I wish all the success to the organizing committee of the 8th Uni-In Alliance 2022.

Senior Professor Sudantha Liyanage
BSc (Hons) (USJ), PhD (Cardiff), C Chem, FRSC, FIChem C, FPRISL
Vice-Chancellor

Message from Prof. Upul Subasinghe

Dean

Faculty of Applied Sciences

University of Sri Jayewardenepura

I am pleased that the Uni-in Alliance students' symposium is held for the 8th time this year despite many constraints in the country. It is a good indication of driving forward the education at the Faculty of Applied Sciences, University of Sri Jayewardenepura. Therefore, I congratulate the organizers for making this event a reality and applaud their dedication and hard work. This event is also an excellent opportunity for undergraduate students to present their final year project work findings in front of academics, industry personnel, and colleagues.

As per the motto of the University of Sri Jayewardenepura, "Vijja Uppathathan Setta", (among all that arises, knowledge is the greatest), the Faculty of Applied Sciences makes every effort to enhance the academic-related experience of its students so that they are equipped with critical thinking and problem-solving skills. The faculty's Honours Degree Program in Applied Science is well-aligned with this concept and it trains the students by exposing them to problem-based analysis in public and private sector institutes. The papers presented in the Uni-in-Alliance Symposium are based on the valuable findings of those students during their project period. The theme selected by the organizers for this year, "Inspiring young researchers for reviving the Sri Lankan economy", is critical and timely in this dark era of Sri Lanka. The selected papers of about 110 in ten different disciplines under the above theme will address the issues faced by the country itself and beyond, providing solutions and methods of the way forward to overcome the current challenges. It is a pleasure to know that many of the students who presented their findings during past symposia are currently working as academics in education institutes and as researchers and managers in various disciplines in Sri Lanka and overseas. I am sure that this year's symposium will also assist the young graduands to develop their talents further and become better scientists who can serve to improve humanity. I wish this event a great success.

Prof. Upul Subasinghe
Dean
Faculty of Applied Sciences
University of Sri Jayewardenepura

Message from Prof. Pahan Godakumbura
Coordinator
B.Sc. (Honours) Degree in Applied Sciences
Faculty of Applied Sciences
University of Sri Jayewardenepura

I am happy to write this congratulatory message for the eight annual undergraduate symposium "**Uni-In Alliance 2022**" in B.Sc. (Honours) Degree in Applied Sciences program of University of Sri Jayewardenepura, Sri Lanka. The symposium is steered with the objective of enabling our students to develop their soft skills such as teamwork, leadership, event organizing, report writing, presentation, and public speaking. Symposium will minimize the gap between academia and industry by enabling both parties to exchanging novel ideas as well as creating employable opportunities to young graduates.

B.Sc. (Honours) Degree in Applied Sciences is recognized as a professional degree program, which is multidisciplinary in nature. It is one of the popular undergraduate degree programs in the country, which caters the needs of the industrial sector. We have evidenced that students have excelled in all fields as they earned research awards by competing with other state university undergraduates. Some of the research findings have pave the way to international journal publications creating postgraduate opportunities in national and international universities.

The 108 students in this eighth batch successfully completed the industrial based research for the past six months despite the **covid-19** pandemic issues and current economic crisis in the country. Today we are going to witness the fruitful outcome of their hard-work. This forum will enable to discuss their experiences and knowledge gathered during their research internships. In line with this year's symposium theme '**Inspiring Young Researches for Reviving Sri Lankan Economy',** the eighth undergraduate symposium will be implemented in a way such that innovations will be fostered to boost up the economy, while educating the youth in the country. This has been done by conducting webinars, seminars, workshops and publishing articles in online and printed media.

I hope that this degree program will be a great opportunity for new graduates, future graduates to learn industrial requirements and future demands while facilitating industries to recruit young professionals to their respective organizational need.
I wish the symposium "Uni-In Alliance 2022" every success!

Prof. Pahan Godakumbura
Coordinator
B.Sc. (Honours) Degree in Applied Sciences
Faculty of Applied Sciences
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08:40-08:45	Welcome address by Symposium chair
08:45-08:50	Speech by Senior Prof. Sudantha Liyanage, Vice Chancellor, University of Sri Jayewardenepura
08:50-08:55	Speech by Prof. Upul Subasinghe, Dean, Faculty of Applied Sciences, University of Sri Jayewardenepura
08:55-09:05	Video Presentation (Introduction and Sponsorships)
09:05-09:55	Keynote Speech
09:55-10:30	Tea Break
10:30-12:30	**Session 1:** Oral and Poster Presentations
12:30-13:15	Lunch Break
13:15-15:15	**Session 2:** Oral and Poster Presentations
15:15-15:30	Tea Break
15:30-15:40	Speech by Prof. Pahan Godakumbura, Course Coordinator, B.Sc. (Honours) Degree in Applied Sciences
15:40-16:40	Entertainment Item
16:40-17:35	Awarding Ceremony
17:35-17:40	Concluding remarks and vote of thanks by Secretary, Society of Industrial Scholars
17:40-17:45	National Anthem

	Session 1: Oral Presentations – Morning Session					
	AMT	**CHE**	**BSC**	**PST**	**MMA**	**APHY**
10:30-10:50	A Mixed-Integer Quadratic Programming Model for Cut Order Planning Optimization in the Apparel Industry. **Dinushika G. K. H.**	Characteristics of Various Sugarcane Biomass-Derived Biochars from Laboratory and Barrel Techniques. **Aluthge A. M. D.**	In-Vitro Investigation of Antioxidant Activity of the Leaves of Rhinacanthus Flavovirens (Acanthaceae). **Hewapathirana S. M.**	Soya Flour as Sustainable Filler to Replace Carbon Black in Tire Tread Compound. **Bopeththa B. V. S. N.**	Factors Affecting Employee Engagement: A Study of The National Agriculture Research System of Sri Lanka. **Ali F. N. J.**	A Study of Mechanical Properties and Microstructure of Graphene Oxide Modified Cement-Based Composites. **Deemantha U. L. A.**
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	AMT	CHE	BSC	PST	MMA	APHY
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	AST	CHE	PST	FSM	IEE	RSD
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	Session 1: Poster Presentations – Morning Session					
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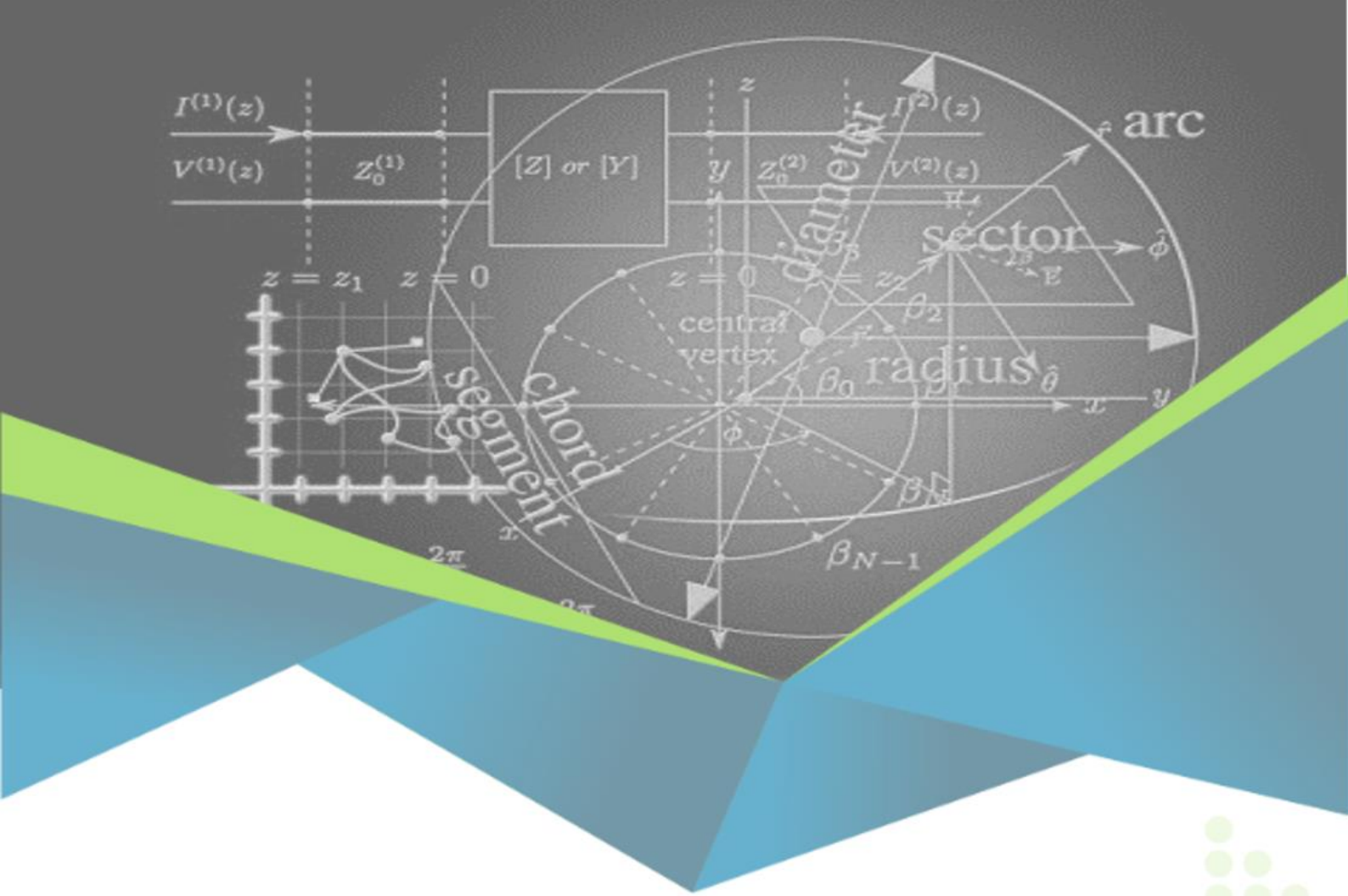
	AMT	CHE	BSC	PST	MMA	APHY
11:30-11:50	Identifying the Proper Reorder Level in Order to Optimize Raw Material Inventory Cost of Inqube Global Pvt Ltd. **Sandamali K. H. C. R.**	Development of An Alternative Method to Determine Available Carbon Dioxide Content and Excess Alkali Content of Commercial Product Y. **Gunasekera R. A. P. C.**	Impact of Water Quality Parameters on Algae and Cyanobacteria Composition and Abundance in Three Dry Zone Reservoirs in The Ampara District. **Igalawithana A. T.**	Investigating the Effect of Surfactant on the Latex Film Formation Process of Synthetic Polyisoprene by Transmission Electron Microscopy. **Kumari S. D. A. I.**	Intention of Consumers in Western Province Sri Lanka: With Special Reference to Consumer Electronics Industry and Cosmetics and Personal Care Industry. **Wijesooriya S. T.**	Study of Physical Testing Methods and Evaluation of Measurement Uncertainty of Standard Physical Testing Methods of Textile Testing. **Senaweera G. G. N.**
11:50-12:10	Analysis of On-Time Delivery (OTD) Failures: A Case Study of Brandix Essential – Ratmalana. **Sampavy P.**	Quantification of Dicyandiamide Tautomers In Milk Products Using FTIR Spectroscopy Analysis. **Nanayakkara N. G. D. D.**	Study the Effectiveness of Ur- 3 Gene in Controlling Bean Rust in Upcountry Intermediate Zone in Sri Lanka. **Virajini M. P. T.**	Polyalinine (Pani)/ Reduced Graphene Oxide (RGO) Composite for NH_3 Sensing Applications. **Upawardhana H. M. S. K.**	Customer Purchasing Intention of Emerging Markets: Special Reference to The Status of The Floriculture Industry in Sri Lanka. **Piyarathne M. A. M. B.**	Standardization Protocol for Calibration of Pressure Measuring Equipment (Without A Pressure Input Port). **Abesundara T. M.**
12:10-12:30	A Study of Factors Influencing Absenteeism of The Machine Operators in Sewing Sector at Miami Clothing Pvt (Ltd). **Priyadarshani J. A. D.**	Study the Land Use Management Practice to Investigate Impact of Human Encroachment in Model Forest Villages. **Rajapaksha N.**	Development of Suitable Carrier Materials for The Efficient Activity of Microbial Formulations. **Wickramasinghe W. M. A. L**.			Intermediate Checks for Power Meters. **Mathangaweera V. L.**

	Session 2: Poster Presentations – Evening Session					
	AST	**CHE**	**PST**	**FSM**	**IEE**	**RSD**
13:15-13:35	COVID-19 Data Visualizatio N Using Spatio-Temporal Data: Application to Covid-19 Data in Sri Lanka. **Kulathunga K. K. S. D.**			Determination of the Correlation Between RCL, Turbidity and The Presence of Coliform in Water. **John L.**	Identifying Feasible Strategies to Reduce Organizational Carbon Footprint: A Case Study for Stationery Industry. **Abeykoon A. M. R. S.**	
13:35-13:55	Analysis of The Main Operational Customer Complaints in Western Province and Forecasting Water Consumption in Dehiwala Area of National Water Supply and Drainage Board, Sri Lanka. **Kumari W. H. S. K.**			Evaluation of The Sri Lankan Groundnut Variation for The Peanut Butter Production. **Nadeeshani Y. K. P.**	Impact of Forest Stewardship Council Certification on Selected Ecosystem Services of Rubber Plantation Sector: A Case Study. **Amarasinghe D. M. I. S.**	
13:55-14:15	Impact of Work Stress and Organizational Culture on Work- Life Balance of Customs Officers in Sri Lanka Customs. **Perera D. M. P.**			Microbial Quality and Genetic Analysis of E. Coli from Bulk Milk in Southern Province, Sri Lanka. **Rathnayake R. M. A. R.**	Determinants of Employee Motivation in The Shared Services Travel Sector in Sri Lanka. **Andradi V. N.**	A Method to Calculate the Cost of a Train in Sri Lanka Railways. **Kularathna K. H. K. V.**

	AST	CHE	PST	FSM	IEE	RSD
14:15-14:35	Determinants of Transportation Cost for Imported Commodities in Sri Lanka. **Rithmi D. L. G.**	Effectiveness of Auxiliars On Chemical Oxygen Demand Level in Polyester Yarn Dye Effluent. **Saputhanthri S. K.**	High Hardness Tread Compound Development for The Solid Tyre Using Variations in Silica Filler Content. **Wickramarathna R. K. W. B.**	Formulation of Healthy Cooking Oil Using Coconut Oil and Rice Bran Oil. **Subasinghe S. A. K. S.**	An Investigation of Customer Profitability: Application of Quantity Optimization Using Linear Programming. **Bandara K .M E.H.**	Voice to Pose Converter Program for Humanoid Robotics. **Perera S.P.**
14:35-14:55	Analysis of Difference Between Engineering Estimate and Approved Bid Value in Engineering Function at Ceylon Petroleum Storage Terminals Limited. **Silva S. K. B. D.**	Identification of Process Steps and Chemicals Affect on TDS Of Treated Textile Factory Effluent and Development of Filter Material to Reduce TDS. **Thilakarathna A. M. S. B.**	Reduction of Heat Press Mark in Sew-Free Fabric Bonding. **Siriwardhana S.P.R. K.**		Analysis of Sustainability Indicators of Emjay International Pvt Ltd. **Perera H. A. M. A.**	
14:55-15:15	Identification of Factors Affecting the Efficiency in Apparel Industry - Sri Lanka **Siriwardhana N. R.**	Quality Analysis of Different Size Fractions of Matured Municipal Solid Waste Composting Feedstock for Optimum Compost Recovery. **Dissanayak E D. D. M. R. P. K.**			Factors Influencing the Household Saving Patterns During COVID 19 Pandemic: Case Study Conducted in Western Province, Of Sri Lanka. **Rajakaruna R. M. P. K.**	
12:30-12:50					Development of Inventory Management System for Monitoring Efficiency. **Wijekoon W. M. C. J.**	



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A STUDY OF FACTORS INFLUENCING ABSENTEEISM OF THE MACHINE OPERATORS IN SEWING SECTOR AT MIAMI CLOTHING PVT(LTD)

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The study aims to identify the factors that give rise to the absenteeism and to find out the most influential factor/factors that lead to the absenteeism of the machine operators. A questionnaire was used to gather the information and accordingly, the sample size was 220 from the 500 operators and simple random sampling method was used. And also one month was covered by the study. Descriptive statistics techniques were used to identify the pattern of the sample and the relationship among the variables were found out by Mann Whitney test, Kruskal- wall's test and by the correlation analysis. Regression model was generated to analyze the data. Dependent variable was the rate of absenteeism and marital status was kept as the dummy variable with presence of children, experience, employee salary, incentive, family responsibilities and health problem as the independent variables. Majority of participants were found to be females with 93%. The results depicted that most of the employees take casual leaves which was approximately 42% from the participants. This study reveals that there was a statistically significant association between the absenteeism rate and factors which were experience, employee salary, incentive, family responsibilities and health problem respectively relatively married machine operators.

Keywords: *Absenteeism, factors, machine operators, sewing section*

A MIXED-INTEGER QUADRATIC PROGRAMMING MODEL FOR CUT ORDER PLANNING OPTIMIZATION IN THE APPAREL INDUSTRY

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In the apparel industry, cut order planning is an important procedure of planning of cutting a given fabric length into a large number of pieces of different shapes and sizes economically. Cutting fabric for this purpose only by visual inspection leads to the wastage of the fabric while also being time-consuming. Hence having a good cut order plan is important as it saves fabric, time, and labor. To solve this acute problem in the apparel industry, this study proposes an optimization model for designing a suitable cut order plan for a given situation. A mixed integer quadratic programming model has been developed and it was solved using the LINGO software. This model was validated by using it for proposing new cut order plans for earlier cases where cutting of the fabric was carried out only by visual inspection. It was found that the proposed new model has always produced many superior results.

Keywords: *Cut order plan, Mixed integer quadratic programming, Optimization*

ANALYSIS OF ON-TIME DELIVERY (OTD) FAILURES: A CASE STUDY OF BRANDIX ESSENTIAL – RATMALANA

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The aim of this project is to analyse and attempt to develop an on-time delivery (OTD) improvement model for Brandix Essential Limited, apparel manufacturing company. First part of the research is a preliminary analysis based on the details derived from the dashboard with basic data of factors impacting OTD.As per the results of the figures and tables derived, an attempt to formulate a multi objective function is executed incorporation with a basic statistics software Minitab 16 and data analysis tool MS Excel Solver. The database associated with the model defines all the data received and updated from the Brandix Essentials Limited factory Units. It is expected to improvise and implement the proposed model in a selected manufacturing factory to verify the application of the model in the future. In this particular study, an investigation has been carried out to find the major causes of OTD problems of that manufacturer, with a view to implementing and validating the proposed model.

Keywords: *On Time Delivery, Short Shipment, Order Delay, Apparel Manufacturing Company, Brandix Essentials*

FORECASTING THE PADDY PRODUCTION IN SRI LANKA & ANALYZING FACTORS AFFECTING THE PADDY PRODUCTION WITH SPECIAL REFERENCE TO MATARA DISTRICT

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The purpose of this study is to look at the past, present, and future trends in paddy production in Sri Lanka and to construct a time series model for detecting long-term trends and forecasting for the three succeeding years, projected changes in paddy production. The other main goal of this study is to identify the most relevant factors affecting paddy production in Matara District. Developing an ARIMA model for the paddy production in Sri Lanka has been used to forecast the paddy production. General Linear Model has been used as the modeling approach in this study, to identify the factors affecting the paddy production in Matara District for both yala and maha seasons using Minitab 16. The developed model for the paddy production in Sri Lanka for Yala season is ARIMA (3, 1, 0). MAPE (Mean Absolute Percentage Error) of the fitted model is 20.27 and MAD (Mean Absolute Deviation) is 258.70. ARIMA (3,1,3) is the best time series model to forecast the paddy production in Sri Lanka for Maha season. MAPE of the fitted model is 14.19 and MAD is 274.03. Results from the study indicate that Method of irrigation and Adverse effects on crop are the factors affecting the paddy production in Matara District for yala season. Method of irrigation, source of obtaining of seed paddy and adverse effects on crop are the factors affecting the paddy production in Matara District for maha season. The recommended method of irrigation is Rainfed method for both seasons to increase the yield. Mean yield when the crop is not adversely affected is higher than when the crop is adversely affected but harvested. The recommended method of source of obtaining seed paddy to increase the yield is from the Department of Agriculture only for maha season.

***Keywords**: ARIMA model, forecasting, Mean Absolute Percentage Error, Mean Absolute Deviation*

IDENTIFYING THE PROPER REORDER LEVEL IN ORDER TO OPTIMIZE RAW MATERIAL INVENTORY COST OF INQUBE GLOBAL (PVT) LIMITED

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Success of the Garment industry is not an easy task, because it is difficult to get the competitive advantage over their rivels all among the worlds. InQube Global (Pvt) Limited is one of the leading apparel companies in established under Sri Lankan Laws and Regulations. Their core function is to manufacture and export garment for foreign orders. The company has a regular customer list and their general practice is to purchase raw materials required for each order. This basically means they use the "Just in Time (JIT) Inventory management technique". JIT, is an inventory management method in which goods are received from suppliers only as they are needed. However, InQube has experienced unexpected losses and reduction of customer orders due to mismanagement of raw material inventory. Since the company has failed to fulfill orders on time, few regular customers have already moved to other competitive firms. directly affect to the productivity of the entity, in addition delays in material supply chain leads to increased idle times of machineries and employees, directly affecting the productivity of the entity. Therefore, proper inventory management is essential for achieving business goals and objectives. This qualitative research was conducted by the researcher to investigate the adequacy of the current warehouse management system at InQube Global. The main objective of conducting this qualitative research is to identify a suitable model to reduce the current raw material inventory cost at InQube global (pvt) limited. In addition, this study determines appropriate safety stock level. The research uses real time data which include all the purchase details of major raw materials and packing materials. Throughout the population researcher has selected a raw material item as the sample which is one of the major fabric items used in InQube products. Researcher has compared the total inventory cost of *Economic Order Quantity* (EOQ) and the actual cost of JIT method that is being currently used at InQube. and provided recommendations based on the analysis results. EOQ is a calculation companies perform that represents their ideal order size, allowing them to meet demand without overspending. Inventory managers calculate EOQ to minimize holding costs and excess inventory.Finding of the study implies that EOQ model fits better than the JIT method for inventory management of InQube Global (Pvt) Limited. Raw material inventory consists of two components: the holding cost and the ordering cost. Even though current model minimizes the holding cost of the raw materials, there is a huge ordering cost incurred due to that decision., As a result the total inventory cost has increased than the optimum level. Therefore, the researcher recommends that the entity should order by considering the lowest inventory cost point, as well as should maintain a safety stock as well.

***Keywords**: EOQ model, JIT method, Inventory, Optimization, Lead time*

STUDY ON BRA CUP DESIGN GENERATION AND CUTTING WASTE OPTIMIZATION

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This study is concerned on finding an approach to develop fit ensured bra cup designs in various sizes and styles using geometric modelling techniques and to introduce a method to address the cutting waste issue facing in the moulded bra cup manufacturing industry by optimizing the cutting panel used in manufacturing process and introducing an optimized arrangement of cutting panels on the material. As the initial step of modelling bra cup designs, rectangular surface was described using B-spline surfaces and converted it into the desired bra cup designs in standard sizes. The next concern was to minimize the cutting waste by introducing cutting lines and generating the flat pattern of the bra cup. After the flat pattern of the 3D bra cup design was generated, an optimized cutting panel was introduced and by considering the cutting panel arrangement process on the material as a nested problem, an optimized arrangement was introduced by utilizing operational research techniques. The main findings are the virtual 3D designing method to create bra cup designs which allows to generate different bra designs using b-spline surfaces, the application developed using the proposed bra cup designing method developed in this study and the proposed optimized cutting panel to minimize the cutting waste. The method proposed in this study can use to design different bra cup designs in different sizes with the use of existing bra cup or without using existing bra cup to form the initial shape of the bra cup, to determine the amount of materials needed to create the bra cup design and to achieve maximum utilization of material.

***Keywords**: B-Spline Surfaces, Bra Cup, Designing, Cutting Panel*

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A COMPOSITE INDEX FOR MEASURING THE PERFORMANCES OF THE NATIONAL WATER SUPPLY AND DRAINAGE BOARD OF SRI LANKA

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For an organization, it is important to measure its performance. Key Performance Indicators (KPIs) are such measurements that help to measure the performance of an organization. Even though different KPIs can measure different types of performances, to get an overall idea about performances use of a Composite Index (CI) of KPIs is important. The National Water Supply and Drainage Board of Sri Lanka (NWSDB) makes use of KPIs and has identified nine KPIs under Service, Operational and Financial sectors but a CI was not present. This research's main objective was to develop a CI for the NWSDB. The CI was developed with the aid of Principal Component Analysis (PCA). The secondary data from 2018 to the end of 2021 has been used for the analysis. Before applying PCA, the data was transformed and then PCA was applied to Service, Operational, and financial sectors separately. The first principal component of each sector was selected, and they were defined as Performance Index (PI) of that particular sector. These PIs were functions of KPIs in the respective sectors. Then the Composite Index was developed by aggregating those three PIs together. To bind the values of this CI the mini-max transformation was applied. The final CI proposed ranges from the value of zero to the value of ten. The results show that the behavior of the CI is consistent with the PI in each sector.

Keywords: *Composite Index, Principal Component Analysis, Key Performance Index*

ANALYSIS OF DIFFERENCE BETWEEN ENGINEERING ESTIMATE AND APPROVED BID VALUE IN ENGINEERING FUNCTION AT CEYLON PETROLEUM STORAGE TERMINALS LIMITED

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This paper describes a statistical analysis conducted to find out the factors that are associated with the difference between engineering estimate and approved bid value of outsourced engineering projects carried out at Engineering Function of Ceylon Petroleum Storage Terminals Limited (CPSTL). The data of the projects conducted within the period of 2018-2021 were collected from the quantity surveyors' record books. The analysis was conducted to find the relationship among the variables such as the engineering field, estimation made year, estimation made quarter, value of the estimate, basis of the estimate, work experience of the quantity surveyor, and duration between the time of CPSTL estimation and bid closing. Kruskal-Wallis test, Mann-Whitney test, and Regression analysis were employed in the study. It was found that the level of the basis of the project estimation influences the difference between the engineering estimate and approved bid value. Furthermore, the difference was higher for the project estimations that were based on the Building Schedule Rate (BSR) value. Field experts in CPSTL stated that the variable in the study might change regarding the field according to the use of materials and the types of labor. Hence, it was decided to study each field of Civil, Electrical and Mechanical engineering separately. However, due to the lack of a sufficient number of projects in Mechanical and Electrical engineering to conduct the analysis separately, only the Civil engineering projects were considered for the Regression analysis. It was found that the estimation made year and the work experience of the quantity surveyor had a significant impact on the difference between engineering estimate and approved bid value and the fitted model for relative deviation explained a moderate level (55%) of the total variation.

Keywords: *engineering estimates, bid values, nonparametric statistics*

ANALYSIS OF THE MAIN OPERATIONAL CUSTOMER COMPLAINTS IN WESTERN PROVINCE AND FORECASTING WATER CONSUMPTION IN DEHIWALA AREA OF NATIONAL WATER SUPPLY AND DRAINAGE BOARD, SRI LANKA

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All living creatures need water to survive their lives. It is a very essential element for economic growth and development in any country. Thus, access to improved water supply services is a main role of any developing country. Analyzing customer complaints in water supply services and forecasting water consumption are identified as more useful tools for improving and managing water supply services in water distributed organizations. National Water Supply and Drainage Board (NWSDB) plays a main role in water industry of Sri Lanka. This study was conducted with two main objectives; analyze the customer complaints about main operational water supply services of NWSDB in Western province, Sri Lanka over 2021 and forecasting monthly water consumption using time series analysis in Dehiwala area from January 2018 to June 2022 as 54 consecutive months. Research data were collected from the reports of the Commercial Operation Management System of NWSDB. Complaint analysis was carried out in nine regional management (RM) centers in Western province for six main operational complaint categories. Descriptive analysis and Pearson's Chi-Squared test were done for analyzing complaints data. As the test results, the complaints per 1000 connections of connection leaks, leaks near meters, stop valve leaks and meter block issues were uniformly distributed between nine RM centers. In other complaint categories, complaints per 1000 connections were not uniformly distributed between nine RM centers. In another section, ARIMA models were built for forecasting water consumption levels of the domestic, commercial and religious places in NWSDB. ARIMA models were fitted to the data for each consumer category and it emerged that the most adequate model for data of commercial and religious places was ARIMA (0,1,1) and the most adequate model for domestic data was ARIMA (1,1,1) based on the model selection criterion. These models of each consumer category were used to forecast the monthly water consumption from September 2021 to June 2022 in Dehiwala. These results will help local water decision makers to better manage current water supply services and make long-term plans in response to increasing water consumption. Further, future studies can be expanded this research in other provinces for several years and focused about area wise complaints captured from NWSDB. Moreover, more accurate forecasts could be obtained by conducting other methods, such as Bayesian models and computer technology processes.

Keywords: *ARIMA model, Customer complaints, Pearson's Chi-Squared test, Time series, Water consumption*

AN INVESTIGATION OF FACTORS ASSOCIATED WITH FUTURE EXEPECTATION OF UNDERGRADUATES IN FACULTY OF APPLIED SCIENCES, UNIVERSITY OF SRI JAYEWARDENEPURA

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Every undergraduate has an expectation of what he/she will do after completing the degree when he/she comes to the final year. There may be many reasons that influence them to make that decision. The main objective of this study is to investigate the factors that can lead to that decision. In this study, we investigated the factors associated with the future expectations of undergraduates, faculty of Applied Sciences, University of Sri Jayewardenepura. Furthermore, we also studied how their self-efficacy level has affected achieving their expectations, and what kind of help undergraduates expect from the university to go to their expectations. In order to fulfill these aims, we conducted a retrospective survey by sharing a Google questionnaire. Sociodemographic factors, self-efficacy related factors, and factors related to support from close associates of the undergraduates were collected through this questionnaire. There were ninety-one responses; twenty-seven from the 2002/2003 batch, fifteen from the 2014/2015 batch and forty from the 2016/2017 batch. According to the results, the majority in all three batches wanted to find a job without focusing on higher studies after completing their degree, and the results found that the degree program, idea of going abroad and nature of the expected job have a significant association with the future expectations of the undergraduates. The results also revealed that among all the components of self-efficacy, the confidence level in choosing a career to live the life they wanted to have a significant association with the status of whether the undergraduate had achieved his/her expectations.

Keywords: *Future expectations, Undergraduates, Self-Efficacy, Family/Peer support, Factors*

AN OVERVIEW ON NATIONAL RICE PRODUCTION, CONSUMPTION, AND IMPORTATION: TRENDS AND FUTURE DIRECTIONS

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Rice is one of the staple foods in Sri Lanka. It is an important economic, political, social, and cultural commodity that helps Sri Lanka's food security and development as well as most of the Asian countries. The aim of this research was to investigate the past, present, and future trends in rice production, available rice for human consumption, and rice imports. Further, the study focused on estimating Autoregressive Integrated Moving Average (ARIMA) and evaluated the relationship among the variables using Vector Autoregressive Model (VAR). Due to a lack of available data in the Census and Statistics Department of Sri Lanka for the period 1960 – 2021, secondary data from the United States Department of Agriculture's website related to Sri Lanka's rice industry was used to forecast Sri Lanka's future rice production, rice consumption, and imports for 2022, 2023, 2024, and 2025. Based on the results of the ACF plot (no significant seasonal lags), the analysis revealed that there is no evidence of seasonality in all three variables. Considering the lowest AIC, MAPE, and RMSE values, ARIMA (0, 1, 1) with drift, ARIMA (1, 1, 1) with drift, and ARIMA (0, 1, 2) with drift models were determined as the most suitable models for the production, consumption, and importation of rice respectively. MAPE values of the particular models were 11.4%, 3.64%, and 175.94% respectively. An appropriate VAR model with a maximum of 2 lags was selected based on some information criteria. Results revealed that the forecasted values show an increasing trend in rice production and consumption while imports show a slight decreasing pattern. It was observed from the analysis that short-term forecasts were more efficient for ARIMA models. VAR analysis revealed that neither of the variables was a granger cause for the rest of the variables. The results of this study suggested that the ARIMA model was more efficient than the VAR model in forecasting variables. The findings of this study would be more useful for policymakers, researchers as well as producers in order to forecast future national rice production more accurately in the short run by implementing appropriate measures to develop the rice sector.

Keywords: *Rice Production, Rice Consumption, Rice Imports, Time Series Forecasting, VAR*

COVID-19 DATA VISUALIZATION USING SPATIO-TEMPORAL DATA: APPLICATION TO COVID-19 DATA IN SRI LANKA

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The COVID-19 pandemic has exposed the risks of an unprecedentedly connected world. As of November 19, 2020, more than 56 million people have been infected with nearly 1.35 million deaths, and the number is growing. This thesis mainly focuses to discover the pattern of COVID-19 data using a feature-based visualization approach to the overlapping problem in the charts Confirmed, Deaths and Recovery cases, and vaccine data. This research was conducted based on the Spatial-temporal data according to the COVID-19 data in Sri Lanka considering the past two years of data then confirmed, deaths, recovered, and active cases also been performed considering the waves. Death cases have represented the highest trend and seasonal pattern while the confirmed cases have the lowest seasonal component with a higher trend component than recovered and active cases of COVID-19 data in Sri Lanka. Instead of time series visualization, feature-based representation is more powerful since the feature-based visualization can be easily understood and compare many time series together. And PCA technique was found to visualize many series together with considering many features of time series of COVID-19 data. This approach provides an easily understandable representation of the data.

Keywords: *feature-based, PCA, confirmed, recovered, death*

DETERMINANTS OF CAREER PROMOTIONS AMONG WHITE COLLAR EMPLOYEES IN SRI LANKAN APPAREL INDUSTRY: A CASE STUDY ON MAS SILUETA (PVT) LTD

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The Human Capital of any organization is the utmost important and most valuable asset they have in their possession. Good human capital is hard to find and even harder to retain in the organization. Therefore, career promotions play a huge role in retaining valuable human capital within an organization. Hence, it is the organizations responsibility to look after their employees and give them the recognition they deserve. This study was done to identify factors that determine career promotion possibilities among white-collar employees in MAS Silueta (Pvt) Ltd. A questionnaire was designed with the purpose of collecting relevant data. The dependent variable of the study is the promotion status which is a binary categorical variable. The independent factors used in the study were, Age, Gender, Work Experience, Level of Education, Current Position, Organizational Culture, Nature of Relationship with Superiors, Self-efficiency, and Work Attitude. A logistic regression model was built, and the analysis was done using R programming software. It was found that among the 9 independent variables only Age, Working Experience, Education Level, Work Attitude and Position were significant at 5% level. Age related negatively with promotion status and work experience and work attitude related positively. However, for executive grade position the relationship was positive and for employees with a Master's degree had higher odd of getting promoted. Therefore, this study provides an idea for an individual about the likelihood of getting a promotion within MAS Silueta (Pvt) Ltd and the factors that associate with the chances of getting promoted within the company, which will be a guide for career advancement in the future.

Keywords: *Career Promotions, Human Capital, Organizational Culture, Self-efficiency, Work Attitude*

DETERMINANTS OF TRANSPORTATION COST FOR IMPORTED COMMODITIES IN SRI LANKA

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The transportation cost is a sum of various costs. Those are insurance costs, freight external costs, freight internal costs, and other miscellaneous costs. The cost of insurance and freight is a term used in international trade and only applies to goods shipped by waterway or ocean. Sri Lanka customs is the oldest department which conducts the duty of importing commodities into Sri Lanka. This study mainly looks at the factors that affect the transportation cost for various types of commodities that are imported to Sri Lanka in 2018-2021 and examine how the factors affect the transportation cost. In this research, I considered two commodities which are bulk cement and palm oil. These commodities are based on the types of the ships which are container ship (Palm oil) and bulk ship (bulk cement). Data used are secondary data, from the National Valuation Database Unit of Sri Lanka Customs and this paper has examined the relationship between the factors and the transportation costs using the multiple linear regression model for both commodities. The independent variables of the palm oil model are distances between two ports, origin city (manufactured country), year (year of the import), container type, and package type. Independent variables of the bulk cement model are distances between two ports, origin city, and year. However, the main and most important determinant of the transportation cost of both commodities is known as the distance between two ports. As the results of this study, distance is positively effect to the transportation cost of the palm oil and distances is not significant to the transportation cost of the bulk cement. And all other independent variables have significant effects on the transportation cost per unit of both commodities. However, some categorical variable levels are not significantly related to the dependent variable.

Keywords: *Transportation cost, Freight rate, Sri Lanka customs*.

IDENTIFICATION OF FACTORS AFFECTING THE EFFICIENCY IN APPAREL INDUSTRY - SRI LANKA

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Efficiency is the main key index for measuring progress in the apparel industry. A state of producing a maximum number of quality products with limited inputs, such as labor, money, material, time is called efficiency. It reflects the plant's ability to achieve the best out of available resources, with no to minimum wastage of efforts and expenses. This study was regulated by one of the leading apparel solutions providers in Sri Lanka. The main objective of the study was to identify the factors which were affected production efficiency in the apparel industry. The factory occasionally struggled to carry out its daily plan efficiency due to problems in the departments of Engineering, Human Resources, Information Technology, Marketing, Operations, Supply Chain, and Transport & Administration. These issues were recorded as Lost hours in functional way, calculated by Standard Allocated Hours (SAH). The study carried out with daily data records from eight plants in their daily data system. The data set was finalized by wrangling the data once it had been integrated from all sources. Due to both cross-sectional and time-series dimensions in the dataset, a panel data analysis was applied to conduct the advanced analysis. The difference between the actual and planned efficiency was considered the Lost Efficiency and selected as the dependent variable of the analysis. The relationship between the variables was studied by the correlation matrix. According to the panel regression analysis, problems in Operations, Engineering, Supply Chain, Marketing, Human Resources, Customer, Transport & Administration and the COVID-19 influence have a major impact on production efficiency. Furthermore, issues related to the department of Information Technology were not significantly affected to the production efficiency. Finally, the model was applied to identify production efficiency risk factors and investigate how to mitigate those concerns in the apparel industry to reduce Lost Hours and improve Efficiency.

Keywords: *Standard Allocated Hours (SAH), Efficiency, Panel Data Analysis, Plant*

IMPACT OF WORK STRESS AND ORGANIZATIONAL CULTURE ON WORK-LIFE BALANCE OF CUSTOMS OFFICERS IN SRI LANKA CUSTOMS

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This study was initiated with the primary objective of assessing the impact of work stress and organizational culture on work-life balance of lower ranked custom officers serving in Sri Lanka Customs. Randomly selected 100 lower ranked custom officers were selected for the study and simple random sampling was used to collect data. Primary data was collected thorough an online questionnaire that met accepted standards of reliability and validity. Spearman's correlation analysis was applied and found that there were significant associations between employee work stress and organizational culture with work-life balance. A binary logistic regression model was then developed to investigate the impact of work-stress and organizational culture on work-life balance. The results of the study show that work stress has a significant negative relationship with the work-life balance of lower-ranked customs officers. The direct impact of work stress on work-life balance was also statistically significant. Moreover, the organizational culture in Sri Lanka Customs was identified as a work-life support culture in which employees manage multiple roles in their lives, though the job was highly stressful. Further, it can be concluded that maintaining a good organizational culture and managing employee work stress helps employees to maintain work-life balance. The findings of this study will guide organizational decision makers to modify work arrangements and implement work-life balance according to organizational culture.

Keywords: *Work stress, Work-life balance, Organizational culture, Sri Lanka Customs*

IMPACT OF WORKING FROM HOME ON PRODUCTIVITY AND MENTAL HEALTH OF EMPLOYEES IN DIGITAL LAB, RESEARCH AND DEVELOPMENT, SRI LANKA TELECOM (PLC) DURING COVID – 19 PANDEMIC 2021

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Working from Home (WFH) during COVID - 19 created a new way of working during the epidemic and between 2020/21. All the organizations, governments, and workplaces across the world were showing a tendency to work from home (WFH) concept and there was a gradual increase in work from home worldwide. This survey was conducted to identify the factors that affected the service productivity and mental health of IT sector employees when they work from home during the covid-19 pandemic and to understand the best way to work with increased productivity. An online questionnaire was distributed and 63 responses were collected. Pearson Chi-Square test and Cumulative ordinal logistic regression was used to investigate the factors affecting employee productivity and mental health status. The results show that the presence of children under the age of 12 in the home is main reason for the decrease in the productivity of employees. Factors such as job level, monthly income, number of people in the household, having children age less than 12, satisfaction with the working environment, satisfaction with work team support, feeling any physical/mental pain, and family disturbances were found to be significantly associated with employee WFH mental health. Finally, it was found that the productivity of employee when work at office is significantly better than when work from home. These results will be helpful to maintain the productivity and mental well-being of working from home as a whole.

Keywords*: Work from home productivity, mental health, Remote work, Covid-19*

MINIMIZING QUALITY VARIATION OF RONC IN FINISHED GASOLINE BY USING MATHEMATICAL AND STATISTICAL TECHNIQUES

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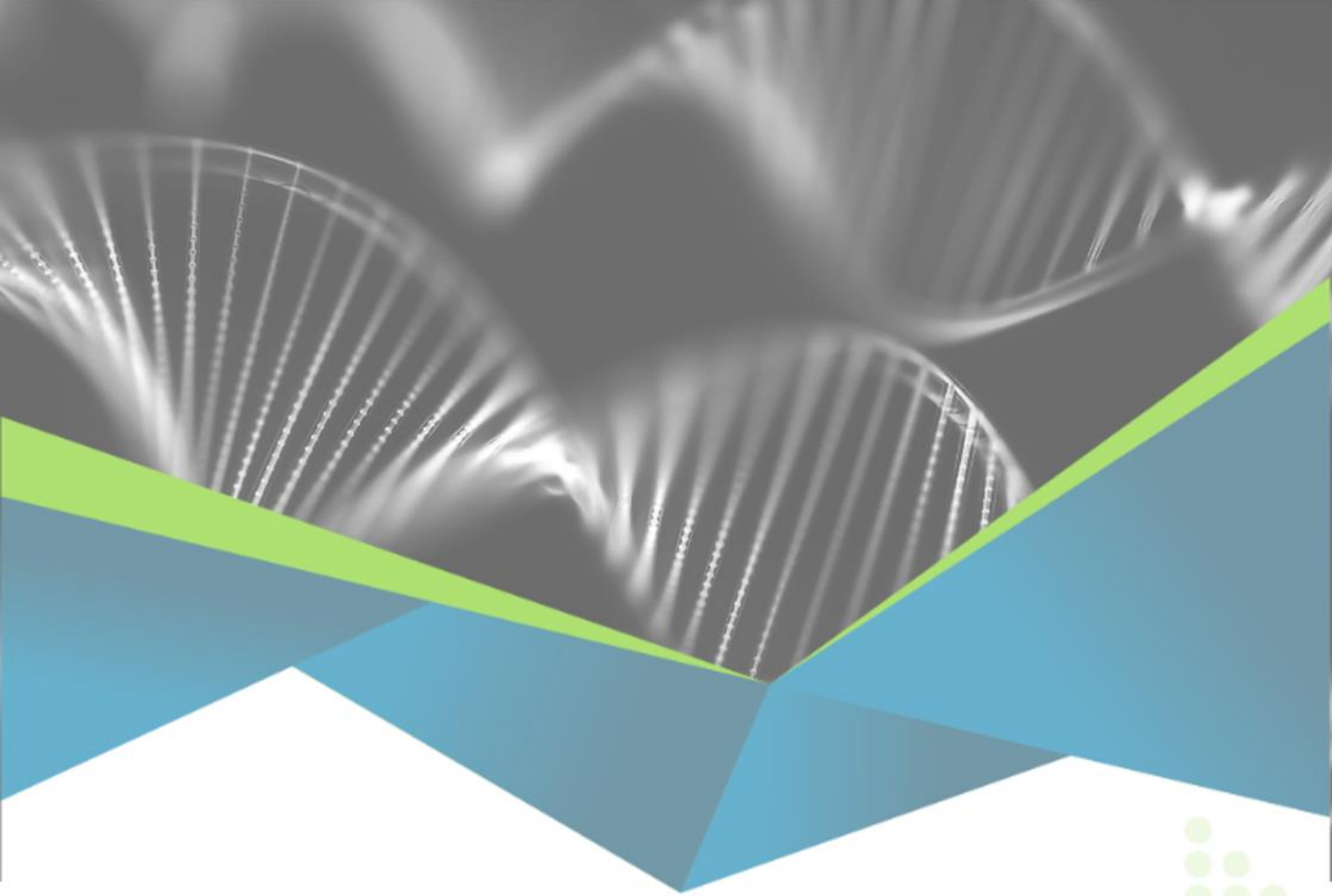
Petroleum industry is a major industry in a country. Petroleum products are mostly used as transportation fuels. The main three transportation fuels are Gasoline (Petrol), Kerosene, and Diesel. Among these fuel types, Gasoline is the primary source of profit in a petroleum refinery. Refineries, distribution companies, and government inspection departments perform gasoline quality control all over the world. This study is considered Octane Number as the key quality characteristic out of Gasoline specifications: Octane Number, Distillation, RVP, Aromatics/Benzene. In the gasoline production, there are two main processes, namely the main gasoline production process with high octane number (the placed octane number in this stage is named as reformate octane number (RO)) and the blending process which converts high octane gasoline to low octane gasoline (RONC). The study is aimed at controlling the RONC of finished gasoline by investigating the interactive effect of reaction factors (controllable factors in the main gasoline production process) on RO. First, nonlinear programming (NLP) model was used to identify RO, which assists in controlling the RONC of finished gasoline at 92 after the blending process (the link between RO and RONC was built by using NLP). 94.3 of RO was identified in this stage. Second, an experiment design was developed based on a central composite rotatable design (CCRD). Third, predictions of regression tree (RT) were applied to collect data for the experiment design, because, the study was used secondary data. Finally, response surface methodology (RSM) was analyzed to optimize regression model. The relationship between RO and reaction factors, namely reactor inlet temperature (500 – 517 ^{0}C), inlet pressure of third reactor (24.14 – 26.21 bar) and space velocity LHSV (1.11 – 1.67 h^{-1}) were shown as mathematical model. R_2 = 86.94% for RO indicated that the RSM model works well with the observed data and was accepted accurate and capable of predicting response. Linear terms of inlet temperature and LHSV, quadratic term of 3rd reactor inlet pressure and interaction term between inlet temperature and LHSV are most effective terms and have an important influence on the response. The predicted RO of 94.3 was obtained at inlet temperature of 510 ^{0}C, 3rd reactor inlet pressure of 25.5 bar and LHSV of 1.14 h^{-1} by numerical findings.

Keywords: *Research Octane Number (RONC), Nonlinear programming model (NLP), Regression Tree (RT), Central Composite Design (CCD), Response Surface Methodology (RSM)*



Biological Science

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AN *IN VITRO* STUDY OF TOTAL CARBOHYDRATES, TOTAL PROTEINS, AND MINERAL CONTENTS OF SOME CYANOBACTERIA ISOLATED FROM SELECTED SALTMARSH AND MANGROVE ENVIRONMENTS OF SRI LANKA FOR NUTRIENT-BASED APPLICATIONS

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Cyanobacteria are photosynthetic prokaryotes with a ubiquitous distribution. They have the ability to produce a broad spectrum of nutritionally important primary and secondary metabolites. Therefore, many nutrient-associated issues like food scarcity and nutrient deficiencies could be successfully addressed with potential cyanobacteria. A few local studies have focused on the cyanobacterial nutrients however, cyanobacteria from saline environments of Sri Lanka are underexplored for their nutrient potential. Thus, this study aimed to investigate the nutrient potential of some cyanobacteria isolated from selected saline environments of Sri Lanka in terms of their total carbohydrates, total proteins, and mineral contents. Fourteen cyanobacterial strains already isolated from selected salt marsh and mangrove environments in Mannar, Sri Lanka, by the Microbiology and Soil Ecosystems Research Project, National Institute of Fundamental Studies (NIFS), were used for the study. The strains were semi-mass cultured in $1/5^{th}$ strength of BG-11 and GO mineral media providing necessary growth conditions such as pH of 7.5, 2000 lux of light intensity with constant illumination, and 200 rpm shaking conditions. At optimal growth, cyanobacteria biomass was harvested, oven-dried, and grounded into a fine powder. Total carbohydrate and total protein contents of dry biomass were analyzed using Dubois' and Lowry method, respectively. Macro and micronutrients were analyzed using Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES). The highest total carbohydrate content of 59.86% was recorded in CYN-1 along with considerably high concentrations of Na (211.88 ppm) and Ca (174.95 ppm). The highest total protein content of 42.77% was recorded from CYN-13. CYN-10-G in the GO medium showed significantly high contents of Ca (228.64 ppm), Mg (65.44 ppm), Fe (33.25 ppm), Zn (3.46 ppm), and Cu (0.997 ppm). The cyanobacteria strains grown in GO and BG-11 showed differences in the carbohydrate and protein profiles showing relatively a high carbohydrate percentage in GO medium along with a high protein percentage in BG-11 medium. Accordingly, strains; CYN-1, CYN-10-G, and CYN-13, were noteworthy compared to previous records of several cyanobacterial nutrient profiles, showing the suitability of the reported cyanobacteria for nutrient-based applications. Moreover, studying such cyanobacteria with a significant nutrient content could also reveal their potential to be applied as biofertilizers to improve soil quality and crop yield.

Keywords: *Cyanobacteria, Nutrients, Saline environments, Mangrove, Saltmarsh*

ASSESSMENT OF SUPPLEMENTATION ADDITION'S EFFECT ON WATER QUALITY AND GROWTH PERFORMANCE OF *Catla catla*

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Catla sp. is the most cultivated species in Sri Lanka, representing a significant part of the total aquaculture production. In past years, profit margins decreased due to cause by harmful pathogens and poor water quality management practices. In National Aquaculture Development Authority (NAQDA), Udawalawa, *C. catla* farming is linked with a high prevalence of pathogens, disease, and water quality problems, which may lead to low survivability and the use of antibiotics. To assess the effects of probiotics as a water additive, the current study utilized a commercial probiotic mixture. Furthermore, this is the first trial study to evaluate the efficiency of Multi-Strain Probiotic (MSP) on *C. catla* culture in Sri Lanka. The field trail was conducted for 8 weeks in which 360 *Catla* sp. fry (0.25 ± 0.1 g) were stocked into 12 cemented tanks with triplicates, where in each replicate 30 healthy fish were stocked in 0.15m^3 cemented tanks. Besides, two management strategies were used: one with the addition of probiotics and the second with commercial feed, each with three replicated. Commercial probiotic mixture 'Profs' was added to tanks as follows: T_C (control: zero probiotic), T_1 (treatment 1: Profs powder at 0.012gm^{-2} weekly), T_2 (treatment 2: Profs powder at dose 0.03gm^{-2} weekly) and B_{T1}, B_{T2} (backup tank 1: Profs powder at dose 0.03gm^{-2} weekly, Backup tank 2: Profs powder at 0.012gm^{-2} weekly). For 8 weeks, the fish in each group were fed a commercial feed up to three times per day. After the experiment period, the dissolved oxygen level (DO) in the treatment tank's water was significantly improved ($P<0.05$). In contrast, ammonia (NH_4) levels were significantly lowered ($P<0.05$) in probiotic tanks compared to the control group. However, other indicators of water quality, such as PH, EC, and temperature, did not significantly improve ($P>0.05$). Additionally, in probiotic-treated ponds considerably increased the host species' survival rate ($P<0.05$; the highest survival percentage in probiotic-treated ponds 92%), many deaths were shown in control ponds. Furthermore, the high dose of probiotic supplement (0.03 gm^{-2}) increases the survival rate of the host species. Moreover, the growth performance parameters (Final body weight, FCR, WGR, LWR, SGR% and k) were calculated according to previous studies. Nevertheless, none of the treatment groups' growth performance measures showed a statistically significant difference ($P>0.05$). Overall, these experiment results revealed that direct administration of probiotic supplements was beneficial for reducing the nitrogen compounds, improved DO level in tanks water, and improving the survival rate of *C. catla*.

Keywords: *Catla catla*, direct administration, probiotics, aquaculture, bioremediation

DETERMINATION OF QUINOLONE RESISTANCE IN COAGULASE POSITIVE *Staphylococcus sp.* CAUSING BOVINE MASTITIS

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Bovine mastitis is one of the costliest diseases in the dairy industry worldwide and an economically significant disease in both developed and developing countries. The disease prevalence is quite high in Sri Lanka as clinical and subclinical mastitis. Coagulase positive *Staphylococcus sp.* is one of the most common pathogen in clinical BM. Although the emergence of antimicrobial resistance in *Staphylococcus sp*. against commonly used antimicrobials has been reported, limited studies have been performed in the country. Therefore, the objectives of the study were to determine the phenotypic and genotypic quinolone antibiotic-resistant profile in a collection of isolates of coagulase-positive *Staphylococcus sp*. The study was done in the Veterinary Research Institute (VRI), Sri Lanka. The isolated samples (n=100) were received from VRI, which were stored at -4 ℃. The isolates were identified by examining cultural morphology, Gram staining and doing standard biochemical tests. Then only the coagulase positive Staphylococcus cultures were selected for the further testing. Total of 24 pure cultures of coagulase-positive *Staphylococcus* isolates were directed to an antimicrobial susceptibility test described by EUCAST guidelines. The standard PCR assay was done to identify Quinolone-resistant genes. The mutations in quinolone resistance-determining regions (QRDRs) of *gyrA* and *gyrB* genes were screened by the conventional PCR as described. The amplified products were visualized by agarose gel electrophoresis. From 100 of samples, 24% of isolates were identified as coagulase positive *Staphylococci* in the study. All the samples showed resistance against the quinolone antibiotic; ciprofloxacin and higher MICs were recorded for nalidixic acid, enrofloxacin in the study. No genetic evidences related to the development of the resistance against FQ were found in this study. The coagulase-positive *Staphylococcus sp.* isolated from clinical mastitis samples has developed resistance against quinolone. The evidence-based antimicrobial usage is encouraged to combat against developing resistance in cattle herds.

Keywords: *Quinolone, Bovine mastitis, Cattle, Antimicrobial, Staphylococcus*

DEVELOPMENT OF SUITABLE CARRIER MATERIALS FOR THE EFFICIENT ACTIVITY OF MICROBIAL FORMULATIONS

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Microbial formulations are introduced worldwide for agriculture to increase the crop productivity with increasing human populations as a substitute of agricultural chemicals. Two major challenges of microbial inocula commercialization are their survival during storage period and effectivity after the applications, resulting in the loss of farmer confidence towards bioinoculum practices. This study aimed to develop suitable carrier media to improve the viability of two microbial consortia that have growth promoting and insect controlling potentials in storage and after application. Four locally available agricultural wastes were selected as biofertilizer carrier materials; biochar, sawdust, sugarcane bagasse, and maize straw. pH of materials were determined using 1:1 dilution method. Initial microbial populations in selected inocula were determined using spread plate method and counting colony forming units. Viability of inoculum populations in carrier materials and biochar-sawdust and biochar-sugarcane mixtures were evaluated for two months storage using suitable media for viable count. The microbial analysis revealed that initial viable count was maintained only by biochar, maize straw, and biochar-sawdust carrier media. Three selected carrier-based biofertilizers were applied to chili plants and the growth effect was determined analyzing height change, number of leaves, and number of flowers. Biofertilizer formulated with biochar reflected the best growth of chili plants. To develop biopesticide, sunflower oil to form two different percentages; 0.5%, and 1% were added to the testing microbial inoculum. Viability tests revealed that only 0.5% sunflower oil concentration can maintain initial microbial counts during one month storage. Pest control efficacy of sunflower oil formulated biopesticides was determined by following foliar applications to *Paracoccus marginatus* infected *Hibiscus mutabilis* plants. Highest efficacy was performed by the biopesticide with 0.5% sunflower oil. Analyzed data revealed that best carrier material for biofertilizer is biochar and 0.5% sunflower oil for the biopesticide.

Keywords: *Biofertilizer, biopesticide, carrier materials, microorganisms*

EFFICIENT *Agrobacterium* MEDIATED TRANSFORMATION PROTOCOL FOR *Carica papaya* EXPRESSING COAT PROTEIN GENE OF SRI LANKAN *Papaya ring spot virus*

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Papaya (*Carica papaya L.*), family *Caricaceae* is an important fruit grown in tropical and subtropical countries. *Papaya ring spot virus* (PRSV) is the most destructive pathogen of papaya cultivars in Sri Lanka. To overcome the destruction, acquiring resistance to PRSV by expressing the PRSV coat protein gene in papaya has been used successfully. Present study was aimed to develop an efficient transformation protocol by *Agrobacterium* mediated transformation, to express the coat protein gene of Sri Lankan *Papaya ring spot virus* in selected Sri Lankan papaya varieties and regeneration. Sun Lady and local papaya varieties and *A. tumefaciens* strain GV3101 harboring pCP60RS-GFP binary vector containing PRSV coat protein gene of Sri Lankan isolate, kanamycin resistant gene and green florescent marker gene was used. Embryonic calli of papaya were obtained using immature zygotic embryos as the explants. Immature zygotic embryos were excised and inoculated on half strength MS medium supplemented with 10.0 mg/L 2,4-D, 60.0 g/L sugar and 400.0 mg/L glutamine for 8 weeks. *Agrobacterium* colonies were grown in yeast mannitol agar (YMA) and the presence of PRSV *cp* gene was confirmed by PCR. Confirmed colonies were grown in YM broth overnight and the transformation was carried out. Calli were inoculated on half strength MS medium with 50.0 mg/L Kanamycin selective pressure and with cocultivation period of 3 days. Co-cultivated calli were treated with different concentrations of cefotaxime. As the liquid phase for carborundum assisted callus wounding and Cefotaxime treatments, sterile distilled water and callus induction liquid medium were compared. Among them, callus induction liquid medium was found to be highly efficient. The treatment of co-cultivated calli with 500.0 mg/L cefotaxime solution in callus induction liquid medium enabled elimination of excess *Agrobacterium* growth. Also, 500.0 mg/L Cefotaxime incorporated maturation medium (full strength MS basal medium) was highly efficient in somatic embryogenesis. Putative transformed calli were selected under Kanamycin selection pressure for 12 weeks with three subculture cycles. Somatic embryos were observed in survived putative transgenic calli. Presence of the PRSV *cp* gene in putative transgenic calli was confirmed by PCR. As an outcome, present study successfully established an optimized and efficient papaya transformation protocol and somatic embryos from transformed calli were successfully regenerated.

Keywords: *Agrobacterium mediated transformation, Carica papaya, Papaya ring spot virus, Coat protein gene, Immature zygotic embryo, Somatic embryogenesis*

IMPACT OF WATER QUALITY PARAMETERS ON ALGAE AND CYANOBACTERIA COMPOSITION AND ABUNDANCE IN THREE DRY ZONE RESERVOIRS IN THE AMPARA DISTRICT

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Algae and cyanobacteria are photosynthetic phytoplankton that is commonly found on water bodies all over the world. The advancement in domestic and industrial usage and agriculture-based activities that contribute to nutrient enrichment of water bodies create eutrophic conditions that lead to the formation of algal blooms. Several studies have found that most water bodies are highly contaminated with harmful algae and cyanobacteria. Some cyanobacteria species are harmful in various ways: toxin production, taste and odor forming, and filter clogging. Hence, the present study aimed to evaluate the species composition and abundance of algae and cyanobacteria in three dry zone reservoirs, namely Konduwattuwan, Himidurawa, and Rambakan Oya in the Ampara district from November 2021 to March 2022. Algae and cyanobacteria were enumerated using the natural sedimentation method and physico –chemical parameters were determined using standard methods (SLSI 614: 2013). The study revealed the relationship between algal abundance and some physicochemical parameters of water. Potential toxin-producing (*Microcystis* sp., *Cylindrospermopsis* sp., and *Anabaena* sp.) taste and odor forming (*Microcystis* sp., *Cylindrospermopsis* sp., *Anabaena* sp., *Staurastrum* sp., *Pediastrum* sp., *Scenedesmus* sp., and *Cosmarium* sp.), filter-clogging (*Melosira* sp., *Nitzchia* sp., and *Euglena* sp.) cyanobacteria and algae were recorded in three water bodies. 14 phytoplankton genera belonging to four phyla: Chrolophyta, Cyanophyta, Euglenophyta, and Crysophyta were identified. The dominant phytoplankton species in the Konduwattuwan tank was *Cylindrospermopsis* sp, whereas *Microcystis* sp. in Rambakan Oya. *Cylindrospermopsis* sp. and *Microcystis* sp. are dominant and co-dominant in the Himidurawa tank. Due to the Shannon Diversity Index, the Himidurawa had the highest H value which means highest diversity of species in the community whereas the Konduwattuwan had the lowest H value. The recorded physico-chemical parameters were within the standards limit for drinking water except for turbidity (Recommended standards 614:2013). Algal abundance exhibited a significant positive relationship among Temperature (r= 0.668, *P*-value= 0.007), pH (r= 0.591, *P*-value= 0.020), TP (r= 0.796, *P*-value= 0.000), EC (r= 0.635, *P*-value= 0.011), and Color (r= 0.734, *P*-value= 0.002). Due to the findings of the Canadian Water Quality Index, the WQI of the Konduwattuwan tank was 54.02 which means it was at the marginal level and the Himidurawa tank (69.37) and the Rambakan Oya (70.03) were in the fair level. The findings of the study are important for identifying the most appropriate control method (DAF, PAC etc) to overcome the algae and cyanobacteria-associated problems in drinking water reservoirs.

Keywords: *Algae, Cyanobacteria, cyanotoxins, physico-chemical parameters, algal blooms.*

IN-VITRO ANTIOXIDANT ACTIVITIY OF *Flacourtia indica* AND *Psidium guineense* Sw. FRUITS

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Wild fruits and their products have bioactive therapeutic potential. Plant drugs are prescribed due to their effectiveness, high availability, cost-effectiveness, low toxicity, and safer with minimum side effects over synthetic ones. In Sri Lanka, there has been little data available for the bioactive properties of underutilized fruits. However, the bioactive properties of *F. indica* and *P. guineense* Sw. have not yet been fully exposed in Sri Lanka. Therefore current study investigated antioxidant and hypoglycemic activities of two specially chosen underutilized fruit varieties cultivated in Sri Lanka, *Flacourtia indica* and *Psidium guineense* Sw. to scientifically justify the practice in the traditional Ayurveda system. Fruit crude ethanol extracts (CR) were fractionated into hexane (Hex), ethyl acetate (EA) and aqueous (AQ) fractions with increased polarity. Antioxidant activity was determined by total polyphenolic (TPC), flavonoids (TFC), ferric reducing antioxidant power (FRAP), oxygen radical-absorbance capacity (ORAC), DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging assay and $ABTS^+$ (2,2'-azino-bis(3- ethylbenzothiazoline-6-sulphonic acid) free radical scavenging assay. The hypoglycemic activity was evaluated by alpha-amylase inhibitory assay. The crude ethanol extract and fractions of *Psidium guineense* Sw. exhibited a high antioxidant potential compared to the crude ethanol extract and fractions of *Flacourtia indica.* Among antioxidant activity ethyl acetate fraction of *Psidium guineense* Sw. contained a higher level of total phenolic content (92.41±8.77 mg GAE/g), flavonoids (28.56±0.22 mg QE/g), FRAP (460.22±24.81 mg TE/g), ORAC (32.39±8.11 mg TE/g), DPPH radical scavenging activities (IC_{50}: 40.23±0.74 µg/ml). Similarly, the highest $ABTS^+$ radical scavenging (IC_{50}:1.43±0.37 µg/ml) was observed in the crude ethanol extract of *Psidium guineense* Sw. Among extract and fractions of *Flacourtia indica*, crude ethanol extract and ethyl acetate fractions had the highest antioxidant activity. In this study, none of the two fruits showed significant hypoglycemic activity. It is concluded that the fruits of *Flacourtia indica* and *Psidium guineense* Sw. will be useful in the development of natural antioxidants with further evaluation of potency and efficacy.

Keywords*: Flacourtia indica, Psidium guineense Sw., fractions, antioxidants, hypoglycemic activity*

IN VITRO INVESTIGATION OF ANTIOXIDANT ACTIVITY OF THE LEAVES OF *Rhinacanthus flavovirens (Acanthaceae)*

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Rhinacanthus nasutus (Family: *Acanthaceae*) is one of the medicinal plants claim to possess anti-inflammatory activity in Sri Lankan traditional medicine, used in the treatments of inflammatory conditions and skin diseases. However, in 2011 it was discovered a Sri Lankan variety of this species *Rhinacanthus flavovirens* and the pharmacological activities of this species is not scientifically evaluated so far. Therefore, this study aims to evaluate the antioxidant activity of the leaves of *Rhinacanthus flavovirens*. The antioxidant activity of *Rhiancanthus flavovirens* was evaluated using an aqueous (AELR) and ethanolic (EELR) extracts of leaves of this plant, where total phenolic content (TPC), total flavonoid content (TFC), DPPH radical scavenging assay and ferric reducing antioxidant power (FRAP) assay were used in the investigation. The results were analyzed by SPSS statistical method. Among both extracts, the lowest dose (100 µg/mL) of AELR showed the highest value of 18.09 Gallic acid/g of sample with TPC and at the dose of 300 µg/mL, EELR showed the highest value of 63.86 Quercetin/g of sample for TFC. For DPPH assay, percentage inhibition values were calculated for each concentration in order to calculate the IC_{50} values for both crude extracts and among them, the IC_{50} values of 412 .14 µg/mL and 955.91 µg/mLwas marked with AELR and EELR, respectively. As for FRAP assay, the lowest dose (60 µg/mL) of AELR showed the highest value of 199.13 Trolox/g of sample. These observations scientifically prove the antioxidant activity of aqueous and ethanolic leaf extracts of *Rhinacanthus flavovirens*, Sri Lankan native herb species and claims its value in Sri Lankan traditional medicines.

Keywords: *Rhinacanthus flavovirens, Acanthaceae, Antioxidant, in-vitro assays*

MACROSCOPIC AND MICROSCOPIC EVALUATION OF THE TRIKATUKADI DECOCTION (TKD) AS PER THE PRELIMINARY STEP FOR THE COMPLETE STANDARDIZATION PROFILE

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Trikatukadi decoction is a notable ayurvedic formula used in successful treatment for *Pakshagata*, correlated with Hemiplegia, nerve dysfunction of the face, limbs and one or both sides of the body, which is the most common manifestation of stroke. Since this decoction has not been subjected for standardization, the ultimate purpose of this research was to carry out an evaluation of the decoction based on authentication of raw materials used in TKD. Accordingly, macroscopic and microscopic appearance was evaluated of all plant ingredient of the decoction. The over exploitation of herbal drugs over recent yeas causes the issues regarding their quality, safety and efficacy. So, this research is based on the identification and authentication of herbal; drugs based on the macroscopic and microscopic evaluation of herbal ingredients which is the cheapest, easiest but the preliminary step of the standardization of a crude drug. In the present experiment 12 plant ingredients of TKD including *Piper longum*(fruit), *Piper nigrum*(fruit), *Zingiber officinale*(rhizome), *Terminalia chebula*(Fruit pericarp), *Terminalia bellirica*(pericarp), *Phyllanthus emblica*(fruit), *Coriandrum sativum* (fruit), *Acorus calamus*(rhizome), *Picrorhiza kurroa*(root), *Azidarachta indica*(bark), *Tinospora cordifolia*(stem), and *Cyperus rotundus*(rhizome) were subjected to macroscopic and microscopic evaluation. Macroscopic studies comprised of shape, size, taste, color, odor etc. while microscopic studies were done by using light microscope. Anatomy of the plant materials were studied by taking thin sections. Accordingly, results were obtained in to photographs for identification of cell arrangements, and special features like starch granules, oleoresins, oil inclusions, pigmented cell layers, and various types of intracellular and intercellular structures, of the plant ingredients. The importance of this study is to authenticate the raw materials used in decoction. After successful authentication process, further chemical and physical evaluation can be carried out. Diagnostic characters that will play a great role in the primary identification and proper authentication of the botanical species of the plant drug. This will be helpful to establish particular standards and helps to minimize the adulteration of preparations. Since this is a preliminary step for the complete standardization profile of crude drug, based on this it is not fair to comes in to a complete conclusion about the crude drug profile, but this is the key step for the complete standardization process of the crude drug.

Keywords: *TKD, Pharmacognostic study, Morphology, Microscopy, Standardization*

PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL PARAMETERS OF WELL-WATER SOURCES IN THE PADUKKA AREA, SRI LANKA

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The rapid changes in developing areas due to constructions, settlements, and agricultural activity cause stress on groundwater quality. This study aims to evaluate the physical, chemical, and biological parameters of well water in the Padukka area. Ten water samples were collected from ten different wells used for drinking to evaluate the well water quality in April 2022. The analytical standard methods given by the American Public Health Association and Ambient Water Quality Standards complied by the Central Environmental Authority, Sri Lanka, were used to analyze and evaluate the well water's hydrochemical parameters. According to the results, the pH values ranged from 4.47±0.01 to 6.00±0.01. pH values of nine sampling points remained below the given guideline pH range of 6.0 – 8.5 in Ambient Water Quality Standards complied by the Central Environmental Authority, Sri Lanka. The suggestion for a low pH value is due to the low pH water in the lateritic aquifer and soil properties. The conductivity of the well-water ranged from 28.2±0.1µS/cm to 280.0±0.4µS/cm. The Pitumpe North sampling point had the highest turbidity (5.90±0.00NTU), exceeding the maximum limit for turbidity in Ambient Water Quality Standards complied by the Central Environmental Authority, Sri Lanka. The concentration range of total phosphate (as PO_4^{3-}) and nitrate (as NO_3^-) ions were $<0.00 mgl^{-1}$–$0.41\pm0.01 mgl^{-1}$ and $<0.0 mgl^{-1}$–$29.7\pm0.0 mgl^{-1}$ respectively. The concentration range of free ammonia was $<0.00 mgl^{-1}$–$0.81\pm0.01 mgl^{-1}$, and the Galagedara East sampling point recorded the highest free-ammonia concentration. 60% of the sampling points were contaminated with *Escherichia coli.* Hence, the direct consumption of water from these wells is not recommended. The results showed that the total iron, total phosphate, nitrate, chloride, and total hardness of all the sampling points were below the respective guideline values of Ambient Water Quality Standards complied by the Central Environmental Authority, Sri Lanka.

Keywords: *pH, Escherichia coli, Well water, Water quality, turbidity*

PRESENT STATUS OF THE MARINE GASTROPOD FISHERIES IN KALPITIYA, SRI LANKA

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Marine gastropods represent about 2% of all mollusks fished around the world. Fishery-dependent reliable statistics are essential as the primary source of information for long-term sustainability of the marine gastropods fishery. This study was to understand the present status of potentially exploitable marine gastropods and identify the biological, economic, social, and environmental factors associated with marine gastropod fishery in the Kalpitiya area. Data was collected through participatory observations, key informant interviews, semi-directive interviews, and a semi-structured questionnaire with fisherfolks at fish landing site at Kalpitiya. *Pleuroploca trapezium* (Horse conch), *Turbinella pyrum* (Indian chank), and *Chicoreus ramosus* (Branched murex) were identified as commercially exploitable marine gastropods in the study area. *Pleuroploca trapezium* samples were processed to study the length and weight relationships and morphometric relationship between operculum length and shell length. It was found that *Pleuroploca trapezium* shows a negative allometric growth pattern. Catch per unit effort (CPUE) recorded for *Pleuroploca trapezium* and *Turbinella pyrum* were 201.167 ± 43.2475 and 1.033 ± 1.1592 shells per boat per day respectively. And factors associated with marine gastropod fishery were identified. This fisher community is heterogenous in ethnicity, religion, and fishing experience. There are many opportunities to enhance socio-economic conditions of the fisher communities through promoting marine gastropod fishery.

Keywords: *Gastropod, fishery dependent, CPUE, allometric, Kalpitiya*

STUDY THE EFFECTIVENESS OF *Ur- 3* GENE IN CONTROLLING BEAN RUST IN UPCOUNTRY INTERMEDIATE ZONE IN SRI LANKA

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The common bean (*Phaseolus vulgaris L*.) is a member of the family Fabaceae and is one of the most important pulses in human diets all over the world. Conversely, many biotic and abiotic factors often cause drastic damage to bean cultivation. Among them, bean rust caused by *Uromyces appendiculatus* is one of the main problems in declining yield worldwide and its control is a high priority. Genetic resistance is the most cost-effective strategy for controlling bean rust, other than disease management practices. Genetic resistance induces by several rust-resistant genes denoted by *Ur* – symbol. Among those genes, *Ur-3* confers resistance to many races of *U. appendiculatus* that overcome the resistance of all other named rust-resistant genes in common bean. Therefore, the main objective of this study was to reveal the rust resistance of the *Ur-3* gene containing exotic bean accessions maintained in Sri Lanka and of commercial varieties grown in the Up Country Intermediate Zone. The effect of this gene should be identified to pyramid the *Ur-3* gene with other effective rust-resistant genes and enhance bean cultivars with durable rust resistance. Ten bean accessions /varieties including 4 accessions (Aurora, Chase, 51051, and EC299) with *Ur -3* gene, 2 accessions with other *Ur*- genes (one was *Ur-13*; CSW 643 other was *Ur-3, Ur-4* both included; BelDade RR1) and other susceptible 4 commercial varieties (Kekulu, Gannoruwa green, Sanjaya, and Top crop) were used in this study to reveal the resistance of bean accessions/varieties to the rust disease. The results proved that all *Ur- 3* genes including accessions (Aurora, chase, EC 299, 51051) and *Ur-3, Ur-4* both including accession (BelDade RR1) showed 100% resistance to the bean rust disease prevailing in the Up Country Intermediate Zone with both rubbing and spray method experiments as expected. It indicated the *Ur-3* gene is effective in this zone as solely and also when combined with other rust-resistant genes. In contrast, the *Ur-13* gene is not much effective when compared with the *Ur-3* gene in this zone. Utilizing the bioinformatics tools *Ur-3* gene was analyzed. According to the Phytozome.net database for *P. Vulgaris* assembly V1.0, the *Ur-3* locus contained six putative genes; Phvul.011G193100, Phvul.011G193200, Phvul.011G193300, Phvul.011G193400, Phvul.011G193500 and Phvul.011G193600 were the names of these genes. And results showed that Phvul.011G193500, and Phvul.011G193600 were most probably the *Ur-3* gene or part of that gene because those were closely associated with the resistance induced by the *Ur-3* gene.

Keywords: *Ur-3 gene, Phaseolus vulgaris, Bean rust, Rub and Spray methods, Uromyces appendiculatus*

WATER QUALITY, SPECIES COMPOSITION AND ABUNDANCE OF ALGAE, CYANOBACTERIA, FLAGELLATES AND ZOOPLANKTON IN PARLIAMENT LAKE

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Parliament Lake is a vital water retention area within Sri Jayewardenepura Kotte. A comprehensive network of canals connects the lake. Due to recent population growth and urbanization, the quality of the water in this network has declined significantly. It resulted from several cyanobacterial blooms in the lake and the canal system. As the present study was conducted to assess the water quality and the trophic state of Parliament Lake and to identify the species composition and abundance of algae, cyanobacteria, flagellates and zooplankton. During March and April 2022, between 9.30h and 12.30h, surface water samples were collected according to the APHA's "Standard Method for the Examination of Water and Wastewater, to reflect the entire lake, ten sampling locations were chosen following the previous survey that was conducted by Sri Lanka Land Development Corporation in collaboration with the University of Sri Jayewardenepura in 2021. In-situ water quality parameters were measured at the location and the other chemical analyses were done in the Water Quality and Algae Research Laboratory, University of Sri Jayewardenepura. The measured water quality parameters were compared with standard values defined for aquatic life. The water pH, DO and conductivity were all within the specified limits of 6.52-8.16, 1.64-7.91 mg L^{-1} and 206.2-310.8 µS/cm respectively. Total nitrate, total phosphate and chlorophyll-a values were 0.22-2.46 mg L^{-1}, 0.01- 0.2 mg L^{-1} and 2.33± 0.68-12.87± 0.55 mg L^{-1} respectively. The results showed that, excluding COD, all of the other general water quality parameters were within acceptable ranges for aquatic life. The cell densities of cyanobacteria and algae, zooplankton were over 41,000 and 870 cells/mL. Four different cyanobacterial species; *Microcystis* sp., *Cylindrospermopsis* sp., *Oscillatoria* sp., and *Spirulina* sp. and nine algal species including *Melosira* sp., *Scenedesmus* sp., *Pediastrum* sp., *Tetrastrum* sp., *Phacus* sp. were recorded in the present study. Most of the recorded species belonged to Chlorophyceae. Four rotifer species; *Brachionus* sp., *Keratella* sp., *Trichocera* sp., *Filinia* sp., one copepod species; *Tigriopus* sp., and one cladoceran species; *Daphnia* sp. were reported as zooplankton population in the lake. Rotifers were the most common species among zooplankton. Chlorophyll-a concentrations followed the abundance of cyanobacteria. The results revealed that sudden algae and cyanobacteria blooms leading to eutrophic states could be foreseen shortly due to the degradation of higher chlorophyll amounts and the presence of potential bloom-forming and toxin-producing species in the lake.

Keywords: *Parliament Lake, Water quality, Cyanobacteria, Flagellates, Zooplankton*

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ANALYSIS OF LEAD AND CHROMIUM IN CHEMICAL ADDITIVES OF FOOD-GRADE PAPER AND PAPERBOARDS AND STUDY CAUSES OF THE MICROBIAL ACTIVITY

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Packaging preserves foods from physical, chemical, and microbiological contaminations, that finally can impact their quality and safety. Paper and paperboards (PPBs) are one of the main materials in the manufacture of packaging for direct contact with food; plastic, glass, and metal are the other ones. In the packaging industry, recycled paper is often favoured PPBs made from virgin fibres due to paper recycling is the most eco-efficient and eco-friendly method. One of the main issues with the paper and board made from recycled paper is chemical hazards that may arise from the presence of toxic heavy metal contamination. PPB material may be contaminated with microorganisms in many ways, and it is also one of the great issues regarding biological hazards in the paper board manufacturing process. Microbes that are present in the paper board may penetrate into the food and it may be a health hazard for the consumers. This study aimed to quantitatively analyse total lead and total chromium metal concentrations of the chemical additives used in the paper manufacturing process and identify the sources of lead and chromium. According to atomic absorption spectrometry analysis, the total lead contents in the studied chemical additives were not present at detectable levels by flame atomic absorption spectrometry and the total chromium contents were detected by graphite furnace atomic absorption spectrometry within the range of 3.51-15.03 µg L^{-1}. Other aims were identifying the presence of microorganisms in the final paper products and determining the effects of concentration and effective lifetime of the used biocide on microbial activities. The effective lifetime of the applied biocide was analyzed by using paper chromatography and thin-layer chromatography analysis methods. Six months after PPBs manufacturing, fungi occurred under high moisture conditions (temperature, 10 ℃-30 ℃, and humidity, 85-95%) but were not under normal room conditions (temperature, 30 ℃-40 ℃, and humidity, 75-85%). Anaerobic sulfate-reducing bacteria occurred under both conditions. Addition rates regarding the highest growth control concentration values of the applied biocide were 44 mL min^{-1} and 34 mL min^{-1} per 2000 L, respectively for the fungal activities and bacterial activities. Results were made that the biocide could be degradable in ten months, after applying to the paper material and the effective lifetime of the biocide could be within nine to ten months.

Keywords: *Paper and paperboards, food packaging, lead and chromium contamination, microbial activity, biocide*

APPLICATION OF VERMI-FILTRATION TECHNOLOGY FOR TREATMENT OF WASTEWATER GENERATED FROM FOOD TESTING LABORATORIES

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The present study studied the efficacy of macrophyte-assisted vermi-filtration technology for treating laboratory wastewater generated from the food analysis laboratory at Industrial Technology Institute (ITI), Sri Lanka. Research and testing laboratories generate wastewater during routine operations. This wastewater is mostly discharged into the environment without adequate treatment leading to environmental pollution. The cost-effective vermi-filtration technology can be a promising technology for treating wastewater generated from laboratories. Three laboratory-scale sub-surface vertical flow units were established:1) without earthworms and plants (Control unit), 2) with earthworms (Eisenia fetida) (vermi-filtration unit (VF unit), 3) with both earthworms and macrophytes (Canna indica) (VF + Constructed Wetland (CW unit). Wastewater from the Food Technology laboratory was fed batch-wise with a wastewater feeding rate of 10ml/min and 7 days hydraulic retention time (HRT) for eight consecutive batches. Physio-chemical parameters (Chemical Oxygen Demand (COD), Total Phosphorus (TP), Total Nitrogen (TN), pH, of the influent and effluent of all three units were analyzed to investigate the treatment efficiencies. One-Way ANOVA was performed to evaluate the significant differences in treatment efficiencies. The average COD removal efficiencies of the control unit, VF unit, and VF+CW unit were 60.2% ± 10.7, 71.6± 8.07%, and 72.0% ± 8.86, respectively. Average TN removal efficiencies of the control unit, VF unit, and VF+CW unit were 8.05% ± 5.75, 10.9±6.4%, and 24.9% ±12.84, respectively. Average TP removal efficiencies were 35.84% ± 17.5, 35.84% ± 17.5%, and 40.0% ±16.76, respectively. One-Way ANOVA results showed that the removal efficiencies of COD, TN, and TP are not significantly different. However, the COD removal displayed promising results whereas the means for enhancing TP and TN removal should be further studied. Further long-term studies in pilot-level experiments are suggested as improvements for the present study.

Keywords: *Wastewater, Earthworms, Vermi-filtration, Canna indica, Eisenia fetida*

CHARACTERISTICS OF VARIOUS SUGARCANE BIOMASS-DERIVED BIOCHARS FROM LABORATORY AND BARREL TECHNIQUES

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Biochar has been proposed as a valuable source to ameliorate and enhance soil quality. Economically and technically viable methods for biochar production have become a timely need. This study focused on evaluating the barrel technique for biochar production by comparing its characteristics to laboratory produced biochar. Different sugarcane biomass (bagasse, trash, and mini mill waste) derived biochar was prepared from a muffle furnace by pyrolyzing at 300, 450 and 600°C for 2 h. The biochar was characterized by the amount of yield, pH, EC, bulk density, proximate and ultimate analysis, SEM and FT-IR characterization. The experimental data indicated that yield and volatile matter content have decreased, whereas pH, EC, moisture, ash, and fixed carbon content increased with increasing pyrolysis temperature. The bulk density of all the biochar was in the range of 0.18 to 0.27 g cm^{-3}. The yield, EC, bulk density, and volatile matter content of barrel biochar showed similarities to 600°C pyrolyzed biochar. The moisture and ash content of barrel biochar was significantly higher than that of 600°C pyrolyzed biochar. The fixed carbon content of muffle furnace pyrolyzed biochar was in the range of 45.1 to 79.3%, and barrel biochar also found to be in the observed range. Alkaline pH was observed in all the biochar, except in bagasse pyrolyzed at 300°C, which has pH = 6.51. The presence of condensed aromatic rings in the biochar was indicated by the low molar ratio of H/C (0.17-0.29). Biochar samples exhibited heterogeneous, highly porous structures. Many FT-IR spectrum bands corresponding to the muffle furnace pyrolyzed biochar has disappeared in the barrel produced biochar. The study concluded that barrel technique is a viable option for biochar production in the context of physicochemical characteristics and economic feasibility. Based on the outcomes of the study, research can be extended towards potential application in the sugarcane growing soils.

Keywords: *biochar, characterization, physicochemical properties, sugarcane biomass, pyrolysis temperature*

DETERMINATION OF THE BIOCHAR EFFECT ON SOIL FERTILITY OF LONG-TERM SUGARCANE-GROWING SOILS

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There is a possibility of deteriorating the quality of soil in long-term sugarcane growing fields over the years. Improvement of soil quality parameters and nutrient retention in soil could be positive facts for sustainable soil health. Biochar has been recently identified for its potential to enhance the soil quality. Limited number of studies have been recorded regarding soil improvement using biochar in crop fields in Sri Lanka, however no reported studies on sugarcane bagasse biochar effect on soil in sugarcane growing fields. This study deals with the influence of sugarcane bagasse biochar produced from two methods; the muffle furnace method (pyrolyzed under 450 °C) and barrel method, on the chemical and physical properties of soil, in Uda Walawe long-term sugarcane growing fields. In addition to that biochar effect on leaching of nutrients and agronomic performance of sugarcane was studied. The pot experiment was conducted for 3 months with biochar at the 2.5% (w/w) application rate in soil with commercial fertilizers. Application of biochar exhibited significant differences for pH, EC, organic carbon, N, P, K, Ca, Mg and Zn contents in soil compared to control. Barrel and muffle furnace made biochar added soils exhibited 12.37% and 11.83% increment in total N respectively. Available P increment was 6.15% and 20.09%. Increment in exchangeable K levels were 13.04% and 8.16% in barrel and muffle furnace made biochar mixed soils respectively. Barrel made biochar exhibited a positive effect on Zn retention in soil. By addition of biochar organic carbon percentage in soil increased by 1.38% and 1.30% respectively. Other benefits included increased soil pH, EC and water holding capacity. Application of both biochar types exhibited positive effects on reduction of nutrient leaching. Production of biochar from barrel method was economically feasible compared to production from muffle furnace. Results of the study concluded barrel made biochar as an economically feasible soil amendment for application in long-term sugarcane growing soils for sustainable quality improvement.

Keywords: *Biochar, Soil fertility, Nutrient leaching, Sugarcane, Bagasse*

DEVELOPMENT AND VALIDATION OF AN ANALYTICAL METHOD FOR THE ESTIMATION OF PARACETAMOL RESIDUES ON DRUG MANUFACTURING EQUIPMENT SURFACES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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Pharmaceutical manufacturers are required to show that their manufacturing equipment cleaning procedure can eliminate drug residues from machine surfaces below an acceptable upper limit. A validated analytical method is required to confirm if cleaning has been performed to an acceptable level. The purpose of the analytical method validation is to ensure that the method is able to accurately and reliably be used for its intended purpose, which in this case is to quantify the residues accurately. An HPLC based analytical method was developed and validated in this study to estimate residues of Paracetamol on manufacturing equipment surfaces after the manufacturing of Paediatric Paracetamol Oral Solution BP. The validation of this analytical method to be used for cleaning process validation specifically included testing the ability of the method in quantifying API residues recovered from the stainless steel 316L stainless steel material of construction, which was performed as a recovery study using swab and rinse sampling methods. The maximum allowable carryover of Paracetamol in the next product, Salbutamol Oral Solution BP was set at 3.4 mg/cm^2, which translated to laboratory limits of 300 ppm for both swab and rinse samples. The method parameters specified in the British Pharmacopeia for assay testing of Paracetamol Oral Solution were used to quantify drug residues using this analytical method, and tests to evaluate performance characteristics of the method were performed for the validation approach. No interferences from solvents and other auxiliaries were recorded, confirming method specificity. The precision of the method was validated to be within the acceptable range. Instrument responses were linear (r^2 = 1.000) over a concentration range from 0.4 ppm to 450 ppm. The LOD and LOQ of the method was determined to be 0.1 ppm and 0.4 ppm respectively. It was determined that a recovery factor of 1.32 needs to be applied during quantification of residues from swab samples, while no such factor was needed for rinse samples, and swab samples were stable for 52 hours from preparation. The results of the experiments indicated that the developed analytical method satisfies the minimum requirements for performance criteria established by the ICH in order to be validated as fit for use for the intended purpose.

Keywords: *Analytical Method Validation, Paracetamol Oral*

DEVELOPMENT OF AN ALTERNATIVE METHOD TO DETERMINE AVAILABLE CARBON DIOXIDE CONTENT AND EXCESS ALKALI CONTENT OF COMMERCIAL PRODUCTY

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The research is about determination of available carbon dioxide content and excess alkali content of commercial product Y. Commercial product Y is a powdered antacid compound, with two main ingredients: Citric acid and Sodium bicarbonate. The major objectives of the research are to propose an alternative test method to determine available Carbon dioxide content and to find out the most accurate method to determine excess alkali content of commercial product Y as Sodium bicarbonate. Determination of the Total Carbon dioxide content of the commercial product Y is a critical chemical test, to determine the amount of active Sodium bicarbonate in the powdered form. Currently, use the Schroedtor's apparatus method. This research proposed and tested an alternative method to determine the available Carbon dioxide content of the product using available resources at the laboratory simply by measuring the initial and final weights of the solution prepared with water and product Y. The basic theory of the alternative method is the initial weight of the solution must be equal to the final weight of the solution + emitted Carbon dioxide gas since the weight of water is not changing during the reaction. As per results, the alternative method is not accurate. During the emission of Carbon dioxide as gas, trapped water droplets escaped from the beaker and hence the final weight of water was not equal to the initial. Therefore, proposed alternative method was not a success. Determination of excess alkali content (as Sodium bicarbonate) of commercial product Y is another critical chemical test. It reflects the acid neutralizing capacity of the product. The research suggested and tested an alternative method to determine excess alkali content of the commercial product Y. Currently using method is a titration between Sulphuric acid and Sodium Bicarbonate which contains in the product. Alternative method has the same theory but with specific changes in procedure and results was more accurate than currently using method. Hence the method was considered as a successful alternative to determine excess alkali content of commercial product Y.

Keywords: *Carbon dioxide, excess alkali, alternative test methods*

EFFECTIVENESS OF AUXILIARES ON CHEMICAL OXYGEN DEMAND LEVEL IN POLYESTER YARN DYE EFFLUENT

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Chemical Oxygen Demand level in polyester yarn effluent at Naturub Exports International had been reported the highest amount among other effluents of Cotton and Nylon in December 2021. Naturub Exports International is a company which produce garment wear accessories like under wear accessories, fashionable garment accessories and active wear accessories. Three types of yarn dyed there at high temperature and high-pressure conditions. They have mainly three methods of dyeing. They are, package type, hank type and bullet type. The raw materials they mainly use are yarn and other auxiliaries which are mixed with water (wet method) and are dyed at high temperatures and high pressure. Main Objective of this research is to reduce chemical waste in Polyester yarn dyeing process by changing the auxiliaries present. Under that main objective, Specific Objectives are to reduce COD level of Polyester yarn dyeing process by 10%, to reduce Total Suspended Solid level and Total Dissolved Solid level in Polyester effluent and to adjust pH level in Polyester effluent. The methodology consists of four steps. The first step is to select the fast-moving recipes and dye them with the current auxiliaries. Next one is to calculate the Chemical Oxygen Demand level of those dyed effluent. Then the auxiliaries in the current recipes are to be replaced with the new auxiliaries and to be dyed again. The final step is to measure COD levels of those samples as well. The apparatus and other chemicals needed are supplied by the laboratory of the company itself. They are Reflux apparatus, Pipettes Beakers, Volumetric flasks and Burettes. The chemicals needed are Potassium dichromate (oxidation agents), Sulphuric acid, Mercuric sulphate ($HgSO_4$), Ferrous ammonium Sulphate $\{(NH_4)_2\ Fe\ (SO_4)_2.6H_2O\}$, 0.25 N used as titrant, Ferroin indicator. Since it is impossible to replace all the auxiliaries due to time constraints, only the levelling agents of the recipes are changed and checked the COD levels of the recipes. When concluding the results, out of three levelling agents, Viscour 9 shows the lowest COD level in polyester effluent. That concludes out of the rest levelling agents Viscour 9 has the minimum contribution for Chemical Oxygen Demand level.

Keywords: *auxiliaries, levelling agents*

HPLC METHOD DEVELOPMENT FOR THE ANALYSIS OF AMINO ACIDS IN ANIMAL FEED SAMPLES USING o-PHTHALALDEHYDE (OPA) AND 9-FLUORENYLMETHYL-CHLOROFORMATE (9-FMOC-Cl)

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A simple and novel high-performance liquid chromatographic (HPLC) method was developed for the analysis of amino acids: both primary and secondary amino acids in the animal feed samples. All amino acid standards and animal feed samples were pre-column derivatized using o-phthalaldehyde (OPA) and 9-fluorenylmethy-chloroformate (FMOC-Cl) and run through the Shim-pack HR-ODS column (150 * 3 mm, 3 μm i.d.). All the primary amino acids were derivatized with OPA, and a thiol co-reagent, 3-mercaptopropionic acid (3-MPA), to make OPA derivatives more stable. And all the secondary amino acids were derivatized by FMOC-Cl. In this study, four types of animal feed samples, including mash protein supplement animal feed deluxe, broiler starter, special broiler chick booster, and coconut poonac provided by CIC Feeds (Ekala, Sri Lanka), were hydrolysed in 6 N hydrochloric acid for 24 hours at 110 °C in an oven and then analysed by HPLC after pre-column derivatization. Free amino acids naturally present or added externally to the mash protein supplement, broiler starter, and special broiler chick booster samples were determined with 0.1 mol/L hydrochloric acid without performing an acid hydrolysis step. To further improve the performance of the method, several reaction conditions and separation conditions were optimized. During the hydrolysis, tryptophan was destroyed, and threonine and serine were partially destroyed. Methionine could undergo oxidation, and cysteine was not observed as well. Also, asparagine and glutamine were deamidated, resulting in aspartic acid and glutamic acid, respectively. Method validation was performed to demonstrate the linearity, repeatability, specificity, limit of detection, and limit of quantitation. This method could be characterized by high specificity and wide linearity. A linear range with satisfactory regression coefficients (R2)> 0.9900 were reported for all the amino acids. The limit of detection (LOD) was 0.00187 mg/m^3 to 0.0259 mg/m^3. And the limit of quantitation (LOQ) values for amino acid solutions was in a range of 0.00568 mg/m^3 to 0.0787 mg/m^3. With the results obtained throughout the study, the procedure could be successfully used as a method for the determination of both primary and secondary amino acids in commercial animal feeds.

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

IDENTIFICATION OF PROCESS STEPS AND CHEMICALS AFFECT ON TDS OF TREATED TEXTILE FACTORY EFFLUENT AND DEVELOPMENT OF FILTER MATERIAL TO REDUCE TDS

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The second-largest industry in the world that discharges waste water is the textile sector. Discharge waste water may contain different colours and compounds in varying concentrations, which may raise the Total Dissolved Solids (TDS) of the effluent. The BOI zone factories should maintain a TDS level of 2100 ppm. The primary goal of this project is to pinpoint the production processes, treatment processes, and chemicals that have an impact on the high TDS levels of the effluent water. In addition, silica base filter media developed using rice husks (RH) was tested to reduce TDS and colour of treated factory effluent. The TDS, conductivity, pH, and temperature of the water samples of effluent treatment plant; sampled from aquaduct, balance tank, clarifiers, and discharge water, as well as the water samples of water treatment plant; sampled from river water tank, clarifiers, filters, and softeners were measured. While the average TDS of the water treatment process has increased, it has decreased in the effluent treatment process. Additionally, the TDS, conductivity, pH, and temperature of the dye and finishing machine discharge water during the production process were measured. The dye batches responsible for the increase in TDS in the effluent are white, black cotton, black dye clean, black synthetic, black polyester, navy, and drimerine. Those fabric dye batches effect are 0.41%, 3.5%, 0.64%, 0.99%, 0.73%, 1.11% and 0.2% respectively, to raise the TDS above 2100 ppm. Chemicals like salt, soda ash, dye, auxiliaries, acids, and caustic are frequently used chemicals which elevate TDS in dye water by more than 10,000 ppm. This study investigated the use of five silica base filter media to reduce the TDS of factory-treated effluent. Rice Husk (RH) was burned at open environment to prepare rice husk charcoal. RH was pyrolyzed at 400°C for an hour and 450°C for 4 hours for the preparation of RH charcoal (N_2 environment) and RH ash (N_2 environment) respectively. Rice husk ash was developed by pyrolyzing RH at 450°C for 7-8 hours. Polyaniline coated rice husk ash was prepared by reacting aniline, potassium iodate and sulfuric acid with rice husk ash. The TDS, colour, heavy metals, and COD of the treated factory effluent was reduced by polyaniline coated rice husk ash, RH charcoal (N_2 environment), RH ash (N_2 environment), rice husk charcoal, and rice husk ash. Polyaniline coated RH ash was able to reduce the TDS level of treated factory effluent.

Keywords*: TDS, Textile wastewater, Treatment, Rice husk ash, Heavy Metal*

IMPROVEMENT OF THE ADHESION PROPERTY OF WATER-BASED ACRYLIC FLOOR PAINT BY OPTIMIZATION OF THE PAINT FORMULATION

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Water-based acrylic floor paints have been widely used in industrial and domestic floor paints due to their numerous advantages such as eco-friendly aspect, good water resistance, weather resistance, aging resistance, and flexibility at low temperatures. In our recent attempts to formulate an acrylic floor paint was failed to provide the desired adhesion on the smooth cement surfaces and detached from the surface after few months of application. Herein, we report the paint test results after the optimization of the paint formulation in order to improve the adhesion and the strength parameters of the acrylic floor paint. In this study the optimization was carried out by changing the polymeric binder, dispersing agent and the adhesion promoter. The functional group analysis of each chemical component was performed by means of FTIR analysis. The adhesion strength of the paint samples was evaluated using wet scrub resistance test, tape test, and cross-cut test. The test results demonstrated that the pure acrylic paint has a better adhesion compared to the acrylic copolymers. Furthermore, polymer blends exhibited weak adhesion strength than the individual performance of the polymeric binders. The adhesion promoter, triethoxy silane oligomer with tethered epoxy functional group caused a significant improvement in adhesion of the acrylic water-based floor paint. Further attempts with the adhesion promoter to use as a primer was failed which was in good agreement with the previous literature. The paint samples incubated at 60˚C for fourteen days showed increase in their viscosity values with the increase of the adhesion promoter percentage. In addition, the influence of the dispersing agent on improving the adhesion of the acrylic water-based floor paint was found to be negligible.

Keywords*: water-based acrylic floor paint, Polymeric binder, Dispersing agent, Adhesion promoter agent, FTIR*

MECHANOCHEMICAL SYNTHESIS OF HYDROXYAPATITE_UREA NANOCOMPOSITE

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Hydroxyapatite(HA)_Urea nanohybrids displayed significant release properties when compared with pure urea, which is a top candidate to cater to the growing slow or sustained release fertilizer industry. The current HA_Urea nano fertilizer manufacturing facility utilizes electricity of about 94.32 kW that is powered by solar. However, there is a requirement to change the energy source or change the production process to eliminate energy-consuming steps. Hence, the objective of the study is to check the feasibility of the production HA_Urea fertilizer from dry solid raw materials by mechanochemical dry grinding with compression. A 250.0 mL of 1 M Ca $(OH)_2$, and 250.0 mL of 0.6 M H_3PO_4 solutions were prepared. The H_3PO_4 solution was added dropwise into the $Ca(OH)_2$ suspension while it was stirred at 800 rpm for 1 h. The mixture was allowed to settle and oven-dried at 105 ºC. The completely dried residue was ground using a mortar and pestle. Dry solid urea and HA were mixed 1:6 weight ratio. The mixture was thoroughly ground using mortar and pestle for 10 minutes. The powder mixture was filled into the mold, and the required pressure was applied through a hydraulic press. The pellets were characterized by PXRD, SEM, FTIR, and XPS Characterization. The supramolecular hetero synthon between nano HA and Urea has been confirmed from the FTIR and XPS analysis. However, inherited slow-release properties of HA_Urea nanohybrids were also seen with prepared HA_Urea nanocomposites. The HA_Urea pellet synthesized with 10 MT pressure has shown the slowest releasing behavior. The reduction of the crystallinity and the inter planner distance with the increasing pressure was observed from PXRD analysis. SEM analysis has depicted the change of the preferred orientation with applied pressure. Tightly packed HA_Urea shows bulk density reduction with compression. Urea molecules have incorporated with the HA matrix and obtained the most preferred orientation with compression. Mechanochemically dry grinding method with compression can be utilized for HA_Urea fertilizer production. The existing production process consumes 386 kWh and approximately 2% nitrogen loss was also confirmed from the Kjeldahl test. The suggested new method has reduced the energy consumption up to 22.2 kWh and zero nitrogen loss. Therefore, the suggested production method can be used to reduce energy consumption and prevent minor nitrogen losses. The pellets can be used as a slow-release sustainable fertilizer in domestic applications.

Keywords*: slow-release fertilizer, Hydroxyapatite urea nanocomposite, nitrogen fertilizer, Crystal packing arrangement, Supramolecular hetero synthon*

NITROGEN ENRICHED PARTIALLY BURNT PADDY HUSK AS A NITROGEN SOURCE TO IMPROVE GROWTH AND YIELD OF RICE (*Oryza sativa*)

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Urea is the most commonly used inorganic nitrogen (N) fertilizer in the agricultural sector in Sri Lanka. But given the problems related with inorganic fertilizers, the current state of the world clearly demonstrates the need for adopting to eco-friendly farming practices. Partially burnt paddy husk (PBPH) is an organic material prepared by controlled burning of paddy husk which is locally available in higher amounts. It possesses a higher porous structure with a greater adsorption capacity and believed to be a slow released bio-char. In the present study, a N fertilizer was developed by nitrogen enriching hot PBPH with liquid fertilizers and applied to rice plants in order to determine its effect on growth and yield of rice plants. A pot experiment was conducted at the Rice Research and Development Institute, Bathalagoda with eight treatments and five replicates. The treatments included PBPH enriched with Gliricidia extract, PBPH enriched with cow urine, PBPH enriched with poultry manure extract, PBPH enriched with fish tonic, PBPH enriched with compost tea, PBPH enriched with urea, PBPH only and no fertilizer. This experiment was laid out in Completely Randomized Design (CRD). N content of raw materials, liquid fertilizers, N- enriched PBPH and N uptake of plants were determined using Kjeldahl method. Phosphorus (P) and potassium (K) contents of PBPH were determined by using UV-Visible Spectrophotometer and Flame Photometer, respectively. Plant height and greenness (SPAD results) were recorded as growth parameters and finally, number of tillers, panicles, grains per pot and grain weight per pot were obtained as the yield parameters. Significantly, the highest N content (1.735%) of N-enriched PBPHs was found in PBPH enriched with urea while the lowest (0.058%) was found in PBPH only. Significantly, the highest N uptakes (1.98% and 1.86%) of plants were found in PBPH enriched with urea and PBPH enriched with fish tonic respectively while the lowest was found in the treatment where no fertilizer was added (0.56%). SPAD readings, number of panicles, tillers and grain yield were significantly increased in all treatments over PBPH only and no fertilizer. In this experiment, hot PBPH was prepared using a variable temperature pyrolysis technique called "Kun-Tan" method. The temperature range maintained in Kun-Tan maker when preparing PBPH and the effect of temperature on N-enrichment of paddy husk were also studied by pyrolyzing paddy husk under three different temperatures 300 °C,350 °C and 400 °C.The entire study indicated that the application of N-enriched PBPH has improved growth and yield of rice, mean temperature of partial burning paddy husk may exist in between the range of 300 °C-350 °C and N enrichment of PBPH was dependent on the processing temperature.

***Keywords*:** *Nitrogen, partially burnt paddy husk, nitrogen enrichment, Kun-Tan, temperature*

PUBLIC PERCEPTION, AWARENESS AND BEHAVIOR INTENTION ON E-WASTE RECYCLING AND MANAGEMENT IN WESTERN PROVINCE, SRI LANKA

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Electronic waste is defined as waste of electronic or electrical origin. Electronic waste poses a huge risk to the environment. Consumers are the key for the better management of e-waste. Hence, Public awareness is used as one of the key points in the design of an effective framework for e-waste management. For that, there is a necessity for a study of public perception, awareness and attitudes toward disposal practices of e-waste. This study focuses to analyse the factors affecting public perceptions, awareness and behavioural intention that influence e-waste management (EWM) and recycling in the Western province of Sri Lanka by conducting a questionnaire-based survey. The study relies on Theory of Planned Behaviour (TPB) to identify the connection between environmental psychological factors. Statistical analysis was done by using the SPSS version 25 software. Two-sample t-test and one-way ANOVA tests were used to identify the relationship between demographic characteristics towards psychological factors. Chi-square test were used to identify relationship between attitude and behavioural intention on e-waste disposal practices. Descriptive analysis was carried out based on the responses. The analysis was done based on 210 individual responses to an online survey. According to the results, demographic factors affecting e-waste recycling behaviour intentions, awareness, subjective norms, perceived behavioural control, and perception had a relationship with public behaviour intentions towards e-waste and e-waste recycling. From the results, it can be concluded that there is a relationship between attitude and behavioural intention on e-waste recycling practices. Interestingly, 63.33% of the respondents are aware of e-waste, however, 81.90% of them are not aware of the laws and regulations on e-waste recycling and management. Future researchers have a possibility to use these results to develop a practical road map for the e-waste material flow in Sri Lanka.

Keywords: *E-waste, Environmental behaviour, Survey, Younger adults, Theory of the planned behaviour (TPB)*

QUALITY ANALYSIS OF DIFFERENT SIZE FRACTIONS OF MATURED MUNICIPAL SOLID WASTE COMPOSTING FEEDSTOCK FOR OPTIMUM COMPOST RECOVERY

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This study was conducted to assess the potential of recovering an additional amount of compost, like fraction, from post-sieved matured compost. The study was conducted at the Municipal Solid Waste (MSW) composting facility (MIHISARU compost) at Karadiyana waste management facility, Western Province, Sri Lanka. Physicochemical properties such as temperature, pH, organic matter content, electrical conductivity, N, P, and K as nutrients, moisture content, and composition of impurities were analyzed to determine the quality of different sized matured compost fractions. Here, TN, P, K and OM content were determined by the Kjeldahl digestion method, which differentiated the Olsen method/complexion reaction of molybdate and phosphorous by using a UV-Spectrophotometer, the ammonium acetate digestion method by using an AAS and the Walkley and Black method, respectively. The analysis of particle sizes ranging from < 4mm to > 50mm showed that the N, P, and K contents of composting feedstock gradually increase with the increase in particle sizes. The larger size fraction (>50 mm) had 1.71% P, 0.32% K and 2.42% TN with 30.30% organic matter content, whereas the smaller compost fraction (<4 mm) had 0.58% K, 0.81% P and 1.85% TN. The analysis revealed that the nutrient content of matured compost feedstock, irrespective of particle sizes, complied with SLSI standards for MSW compost. Further, it was revealed that mechanical crushing of matured compost prior to sieving increases compost yield up to 60% without causing changes in overall nutrient content of 2.07% TN, 1.05% P, and 0.5% K.

Keywords*: MIHISARU compost, Nutrient content, SLSI standards.*

QUANTIFICATION OF DICYANDIAMIDE TAUTOMERS IN MILK PRODUCTS USING FTIR SPECTROSCOPY ANALYSIS

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Milk adulteration for economic gain and unintended adulteration is widely acknowledged as a severe problem in the dairy industry. Dicyandiamide (DCD) is one of the recent adulterants discovered in milk powder on the Sri Lankan market. Even though there is no internationally agreed 'safe limit' for DCD, it is essential to ensure that there is no DCD contamination in milk products. Available literature states that DCD molecule shows tautomerism; therefore, detecting all DCD tautomers present in milk products is essential in the analytical approaches. DCD adulteration may be identified using several analytical methods, but they often need time-consuming sample preparation, expensive laboratory equipment, and highly skilled personnel. This study aimed to develop a low-cost, reliable method for screening milk products for Dicyandiamide using Fourier-transform infrared spectroscopy (FTIR). Density functional theory calculations (B3LYP/6-31G(d)) was used to study the tautomerism of DCD molecule and their stability. After examining DCD and milk powder FTIR spectrums, two potential peaks at 2200 and 2160 cm^{-1} wave numbers, which are unique to DCD, were identified and used for calibration plot development with peak heights. Further, the computational study found that the selected two peaks are related to two tautomers present in DCD. Therefore, a separate calibration plot was developed integrating peak area under 2200 and 2160 cm^{-1} peaks instead of single peak intensities. In this study, univariate simple regression analysis was employed. A strong linear fit was achieved for each calibration plot, with R^2 values closer to 1. The calibration plots were validated using local raw milk, fresh milk products, and milk powder solutions adulterated with a known quantity of DCD. The calibration plot validation results show that the average recovery percentage for all curves (2160 cm^{-1}, 2200 cm^{-1}, peak area) was 106 ±13.13%. In this study, without any sample pretreatment, a minimum detection limit (LOD) of 0.49 mg/ml and a minimum quantification limit (LOQ) of 1.48 mg/ml were obtained for the 2160 cm^{-1} peak intensity calibration plot. This study's conclusions will be advantageous to the dairy industry.

Keywords: *Dicyandiamide, Fourier-transform infrared spectroscopy, Adulteration, Milk products, Tautomerism*

RECYCLING OF ALUMINIUM BEVERAGE CANS TO MANUFACTURE ELECTRIC CONDUCTIVE GRADE ALLOY RODS

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Aluminium beverage cans are the primary source of aluminium in the trash stream. There are variety of ways to recycle disposed aluminium beverage cans and there are lots of different products that can manufacture by recycling those cans. Manufacturing "Electric Conductive" grade (EC grade) aluminium rod is one way to recycle those cans. These rods use to manufacture cables, conductors, transformer wires/strips and various hardware /general engineering components. The goal of this study is to find the best electric conductivity grade aluminium rod that can be made from discarded aluminium beverage cans. Chemical composition of beverage cans can check by using optical emission spectroscopy. First melted the beverage cans and created three samples. Then checked the chemical composition in those three samples. Mean value of the chemical compositions is taken as 96.8%. ACL cables manufacture three types of aluminium and alloy rods as 1120, 1350 and 6201. By analysing the chemical composition, it shows that the 6201-alloy rod is the most suitable rod type that can manufacture by using disposed aluminium beverage cans. Due to some chemical percentage limitations, beverage cans should mix with pure aluminium to manufacture 6201 alloy rods. Therefore, the maximum amount of beverage can weight that can mix with the pure aluminium is ~ 12Kg and the weight of pure aluminium is 988Kg. According to the calculations, to manufacture 6201 alloy rode, need 1 440 000 beverage cans per year. In Sri Lanka, we import 288 485 037 cans of beverage can annually. So, this amount can easily catch because the amount of disposed is much greater than the amount that needs to manufacture the rod. In ACL cables, they manufacture nearly 1200 MT of 6201 aluminium rods per year. If recycle those aluminium beverages can, ACL cables can save 8 864 361.648 rupees per year.

Keywords: *Beverage cans, Recycle, Composition, Alloy*

SELECTIVE RECOVERY OF LITHIUM FROM SPENT LITHIUM- ION BATTERIES USING α- $Ti(HPO_4)_2.H_2O$ (α-TIP) AS THE ION- EXCHANGER

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Due to the rapid expansion of usage, the projected demand for lithium-ion batteries (LIBs) is huge. Production of lithium from natural sources is lagging behind the demand & the cost of lithium is increasing. Lithium is one of the scarce natural elements in the world & it is needed to be preserved. Spent lithium-ion batteries is a rich source of lithium & it is necessary to develop low cost & efficient recovery methods to recover lithium from them. As Co, Mn, Ni ions are available in a LIB apart from Li, the method should be developed to selectively recover Li. α-$Ti(HPO_4)_2.H_2O$ (α-TiP) is a cation exchanger which possesses a lamellar structure. H^+ are located in the inter- layer space & it is proven that they can be exchanged with small cations such as Li^+ & Na^+. Cations can be retained by chemical adsorption to negatively charged sites. In this study, α-TiP was used to selectively Li from spent LIBs. As the first step, LIBs were dismantled to separate the cathode which is an Al foil coated with $LiCoO_2$. Then it was cut in to ~1mm pieces & placed in the ultrasound cleaner to separate the cathode mixture from the Al foil. The separated mixture was calcined in muffle furnace for 2h at 700^0C. Thus obtained mixture was ball-milled for 60min. According to the results, the powder contained $LiCoO_2$ as the principle component. Then it was leached with 4M HCl at 80^0C for 1h in a 250ml 3 necked round bottomed flask at a speed of 300rpm. Solid:liquid was 0.02g/ml. Concentration of Li & Co in the obtained leachate was measured using AAS. Concentration of lithium and cobalt in the leachate was 1.42g/l and 3.80g/l. Then the leachate was separated in to 3 portions & each portion was placed on a magnetic stirrer with 2g of α-TiP for at room temperature, 60^0C and at reflux conditions respectively. Finally, the concentration of Li & Co retained by α-TiP was determined. Concentration of lithium and cobalt retained at 60^0C were 0.06g/l and 0.09g/l respectively. Concentration of lithium and cobalt retained under reflux conditions were 1.06g/l and 0.86g/l respectively. At 60^0C, amount of cobalt retained by α-TiP is higher than the retention of lithium due to high rate of chemical adsorption. But at higher temperatures, chemical adsorption of cobalt is demotivated and cation exchange of lithium is promoted due to overcoming of energy barrier for cation exchange. Experimental conditions have to be optimized further in order to promote the retention of lithium over cobalt by α-TiP.

Keywords: *selective recovery, spent lithium-ion batteries, cation exchanger, α-TiP , leached*

STUDY THE LAND USE AND LAND COVER CHANGE AND LAND USE MANAGEMENT PRACTICES TO INVESTIGATE IMPACT OF HUMAN ENCROACHMENT IN SELECTED FOREST VILLAGES IN WILPATTU NATIONAL PARK INFLUENCE ZONE

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Wilpattu National Park (WNP) is Sri Lanka's largest protected area with high biodiversity value. It habitats to larger mammals like elephants and leopards. People live in the park's periphery and derive their livelihoods from various occupations. Today, the WNP faces many threats and challenges including human-wildlife conflict due to illegal land encroachment to the WNP restriction zone. This research aims to study land use and land cover change (LULCC) between the 2000 – 2021 period and land use management practices of selected forest villages in 2021 in the WNP influence zone to investigate the impact of human encroachment. 2021 Land use maps of selected villages were developed using base map layers in ArcGIS Pro software to identify human encroachment to the WNP restriction zone. The visual overlay method was performed between the developed 2021 land use maps and the survey department 2000 land use map to determine land use and land cover change during 2000 – 2021. Age-wise & gender-wise distribution of reported human death cases were analyzed using Microsoft Excel to identify the relationship between genders and age groups. In addition, elephant and human death incidents were recorded using GPS coordinates to prepare a risk zone prediction map by Inverse Distance Weighting (IDW) interpolation technique to estimate where conflict was more likely to occur. The results revealed that communities in all selected villages had encroached on the restricted zone. During the last two decades, forest cover declined in villages located in the northern and eastern parts of the influence zone, while villages in the northeastern and southwestern parts have a net increment of forest cover. Demographic data analysis revealed the men in the 15 – 60 years age group which is the region's workforce were the most vulnerable group to elephant attack with their exposure to the environment. The elephant risk zone prediction map identified all areas except the southeastern part of the influence zone as a very high-risk area, and the human risk zone prediction map identified all areas except the eastern part of the influence zone as a very high-risk area. Therefore, it's an urgent need to introduce a long-term land use management plan to save WNP and its adjoining natural habitat.

Keywords: *Wilpattu National Park (WNP), Land use land cover change (LULCC), Geographic Information System (GIS), Inverse Distance Weighting (IDW)*

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A STUDY ON THE PRODUCTION OF A HEALTHY BISCUIT PRODUCT ENRICHED WITH *Spirulina sp.* (*Spirulina platensis*)

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Spirulina platensis is an edible microalga with having high content of proteins and nutraceutical compounds. World Health Organization has labeled them as super food because of they are rich source of various biological active compounds that could be used as functional ingredients. *S. platensis* is consumed as a healthy food in Japan, Taiwan and Mexico over 70 years ago. Now a days, microalgae are receiving high attention in nutritional and food sciences because of increasing awareness of health promoting nutrient compounds and nutraceuticals necessary to avoid various health disorders. The word "Spirulina" is derived from a Latin word, meaning "helix" or "spiral"; indicating the physical configuration of the organism when it forms swirling, microscopic strands. *S. platensis* is filamentous, helical and photosynthetic microalga naturally inhabiting alkaline brackish water and saline water bodies in tropical and subtropical regions.The microalga *S. platensis* is belonging into the Oscillatoriaceae family. *S. platensis* is the most prominent species in this genus Spirulina. But its low palatability is the main barrier for human consumption. This research study aimed to develop healthy biscuit product enriched with *S. platensis* for nutritional enrichment purposes. In this research study, four formulations with having different percentages of *S. platensis* biomass were prepared. They are 00%, 05%, 10% and 15%. These formulations were subjected to chemical analysis and sensory analysis. When considering nutrient content of prepared biscuit varieties, the increase of *S. platensis* biomass percentage led to increment in protein percentage, fat percentage besides increments in minerals, compared with the biscuits not having *S. platensis*. Highest protein and fat content were observed in biscuits having 15% of *S. platensis*. Highest moisture content was shown that biscuits having 15% of *S. platensis* and lowest moisture content was shown that biscuits having 10% of *S. platensis* biomass. In the sensory evaluation of prepared biscuit varieties, colour, flavor, texture and overall accessibility of biscuits having 05%, 10% and 15% *S. platensis* compared with biscuits not having *S. platensis* biomass. It was showed that all 4 variables of biscuits having 05% *S. platensis* did not indicate any statistically significant difference over biscuits not having *S. platensis* biomass ($p>0.05$) according to Wilcoxon signed rank test. According to to the results, biscuits having 05% *S. platensis* biomass can be considered as the solution for low palatability of human consumption because it has no significant flavour or odour and also it has the higher consumer acceptance. In addition to those, this research study can be extended to industrial level for preparation of a new healthy biscuit product to introduce consumer market.

Keywords**:** *S. platensis, Microalga, Micronutrients, Sensory analysis, Food supplement*

A STUDY ON CONTAMINATION STATUS OF *Escherichia coli* IN RAW AND COOKED POULTRY MEAT

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Food –borne diseases have been determined as an emerging health problem in many countries. Poultry industry is the fastest growing livestock industry in Sri Lanka. Many studies have recorded on contamination of poultry meat by pathogens. Chicken is a popular type of poultry meat consumed in Sri Lanka. *Escherichia coli* (*E.coli)* is considered as one of the most common causes of food-poisoning outbreaks all over the world. This study aimed to determine the contamination of *E.coli* in raw meat from two different strata in the market; butcher shops and supermarkets and in cooked meat which is cooked in three different cooking methods from five different kitchens. Isolation and identification of *E.coli* in meat were carried out by the conventional culture methods and confirmatory tests. The presence of *E.coli* was confirmed by Polymer Chain Reaction (PCR) technique with the primers of phoA gene.The virulence of isolated *E.coli* was analyzed by Antibiotic Sensitivity Tests. The highest incident rate of *E.coli* among inoculated samples was in raw chicken. The results indicated a high degree of contamination in samples from butcher shops compared to those from super markets. The incident rate of *E.coli* in chicken samples from butcher shop was 80% and 20% in super markets. In cooked meat samples, grilled chicken indicated he highest incident rate of *E.coli* (12%) and showed the no growth in fried chicken. The results indicate need for applying for proper hygienic practices in food outlets to reduce the incidence of the food diseases. It also indicates the potential of incidence of infection due to post cooking contamination. The different cooking methods apply different effects on growth of *E.coli* based on temperature cooked and composition of cooked chicken. The antibiotic sensitivity shows existence of antibiotic resistant *E.coli* strains in both raw and cooked meat, which is a major health issue due to the failure of medical treatments. PCR confirmed the results of the conventional methods and it is more specific and rapid if directly used.

Keywords*: Escherichia coli, Food-borne infections, Antibiotic sensitivity, PCR*

DETECTION OF ANTIBIOTIC SENSITIVITY OF *Staphylococcus aureus* ISOLATED FROM COOKED RICE PACKETS

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Antibiotic resistance to *Staphylococcus aureus* has evolved in the community forming a serious threat to public health in Sri Lanka. The presence of antibiotic resistant *S. aureus* in foods creates the risk of dissemination of antibiotic resistant pathogens in the community. The objectives of the present study were to determine the antibiotic resistant patterns of *S. aureus* isolated from cooked rice packets received at the Food and Water Microbiology Laboratory, Medical Research Institute, Sri Lanka, and to identify the molecular relatedness of antibiotic resistant isolates using the Pulsed Field Gel Electrophoresis (PFGE). In this study, 80 cooked rice packets were tested which were received from food outlets in Colombo, Polonnaruwa, Kandy and Batticaloa districts to the laboratory during the period November 2021 and April 2022. *S. aureus* isolates were identified according to the Standard Operating Procedure in the laboratory manual of the Sri Lanka College of Microbiology. The *S. aureus* isolates were tested for resistance to 09 different antibiotics using the disk diffusion method according to the Clinical Laboratory Standard Institute guidelines (CLSI). Methicillin Resistant *S. aureus* (MRSA) isolates were identified by cefoxitin (30 µg) disk diffusion test. Inducible clindamycin resistance was identified by disk approximation test. Vancomycin Minimum Inhibitory Concentration (MIC) test was carried out for MRSA isolates using the antimicrobial gradient method. PFGE was carried out according to the PulseNet standardized protocol. A total of 21 *S. aureus* were identified from samples of 80 cooked rice packets. Out of 21 *S. aureus* isolates, 07 (33.3%) were MRSA. Ciprofloxacin and tetracycline resistance in 21 *S. aureus* were 4.7 % and 9.5 % respectively. Vancomycin MIC values for all MRSA isolates (07) ranged from 0.5 µg/ml to 2 µg/ml. It is alarming to see that 33.3 % (07/21) of *S. aureus* isolated from food samples were MRSA. The vancomycin MIC for all MRSA isolates was ≤ 2 µg/ml. Food may act as a vehicle of transmission of antibiotic resistant bacteria. Therefore, the current surveillance should be strengthened with enlarged sample size and periodic monitoring. The transmission means of antibiotic resistant strains of food borne pathogens via the food chain should be identified, and preventive measures should be implemented.

Keywords: *Staphylococcus aureus, Antibiotic sensitivity, cooked rice packets, MRSA*

DETECTION OF Stx1 & Stx2 GENES AND ANTIBIOTIC SENSITIVITY OF *E. coli* ISOLATED FROM FOOD SAMPLES

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Escherichia coli (*E. coli*) is identified as a major food- borne pathogen that causes various types of diseases including mild to severe gastrointestinal illnesses. Shiga toxin-producing *E. coli* (STEC) can be life-threatening as it causes diseases like hemolytic uremic syndrome (HUS), hemolytic colitis (HC). Routine and surveillance food samples including cooked rice packets with curries, dairy and animal based food products, snacks and bakery products etc., received to the Food and Water Microbiology Laboratory, Medical Research Institute, Sri Lanka, from November 2021 to April 2022 were tested for the presence of *E. coli* using most probable number (MPN) method, in this study. Furthermore, the presence of Stx1 and Stx2 genes in isolated *E. coli* was detected using PCR. These genes are responsible for production of Shiga toxin by *E. coli* which can be identified as a main virulent attribute in them. Antibiotic sensitivity test was also carried out with *E. coli* specific antibiotics to reveal the antibiotic susceptibility of food borne *E. coli*. There were 9.31% of food samples, contaminated with *E. coli* and Stx2 gene was detected in 63.16% of isolated *E. coli* from food samples. Serological identification of *E. coli* isolates with Stx2 gene was carried out for the serogroup *E. coli* O157 by the slide agglutination method. None of the isolates belonged to the serogroup *E. coli* O157. All of the investigated isolates were sensitive for antibiotics, Mellicinam (MEL), Gentamycin (CN), and Ertapenem (ETP). There was a resistance in few isolates for Nalidixic acid (NA), Co- trimaxzole (SXT), Ampicillin (AMP), Ciprofloxacin (CIP), Imipenem (IPM) and Trimethoprim (W). However, this study reveals that there are Shiga toxin producing *E. coli* strains contaminated with foods available for human consumption. Thus, maintaining improved sanitary practices hygienic, food handling and processing practices, are highly significant in preventing *E. coli* or STEC contaminations in foods available for human consumption.

Keywords: *Food borne infections, Escherichia coli, Shiga toxin, Antibiotic sensitivity of bacteria*

DETERMINATION OF THE CORRELATION BETWEEN RCl, TURBIDITY AND THE PRESENCE OF COLIFORM IN WATER

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The coliform presence in drinking water is conventionally tested through the chromogenic coliform agar test, which takes about 18 to 24 hours. The correlation between Turbidity, Residual Chlorine(RCl) and Coliform presence was studied to reduce the time taken for this purpose. The RCl, Turbidity and Coliform presence variations in the chlorinated drinking water distributed by the National Water Supply and Drainage Board to the Colombo City region were studied for five months. The area was divided into nine sub-regions, and all of the points covering the sub-regions were sampled. The data were analysed for correlation using regression and bivariate analysis under statistical analysis. The data did not fit the regression model, giving an R Square value of 0.03, and no significant variance was found in coliform presence due to turbidity and RCl, as the p-value was 0.092. Though the correlation model showed a significant relationship between Turbidity and Coliform presence(p-value = 0.620), none were shown between RCl and Coliform presence(p-value = 0.271) and between RCl and Turbidity(p-value = 0.032). The influence of other parameters that affect water quality other than the two considered must be included for a better statistical output. More data with positive coliform results need to be analysed to predict the relationships using statistical methods.

Keywords: *Coliform presence, Residual Chlorine, turbidity, drinking water*

EVALUATION OF SRI LANKAN GROUNDNUT VARIATION FOR THE PEANUT BUTTER PRODUCTION

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In Sri Lanka peanut is mostly consumed as a snack and in confectionary manufacturing. Most of the local peanut production is supplied to the market as row pods because there is no more attention to produce value added products from Sri Lankan peanut varieties. Peanut butter is the important value added product due to its nutritional value, longer shelf life, microbial stability, wholesomeness and ease of consumption. In this study five Sri Lankan groundnut varieties were evaluated for the production of peanut butter and the study was included proximate analysis, sensory analysis and storage stability analysis. Tissa, Lanka Jumbo, ANKG1, ANKGN3 and ANKGN4 peanut varieties improved by the Grain Legumes & Oil Crop Research & Development Centre (GLORDC) in Angunakolapelessa were selected for peanut butter production. Proximate composition of the prepared peanut butter samples were determined using previously described AOAC standard methods. Sensory attributes (appearance, sweetness, taste, aroma, texture and overall acceptability) of the samples were analyzed using five-point hedonic scale with 20 untrained panelists. Storage stability of the peanut butter samples during the 3 months storage time in 2 storage conditions were analyzed by using 3 groundnut varieties belong to three seed classes to find out the effect of seed size of the peanut variety on storage stability of peanut butter. They are ANKGN4 (small seeded,), Tissa (medium seeded) and ANKGN3 (large seeded). All the samples were analyzed for peroxide value, free fatty acids, refractive index and water activity at one month intervals for three months. According to the proximate analysis composition of all peanut butter samples were varied as 0.77±0.045% to 1.08±0.02% moisture, 23.11±0.35% to 27.56±1.09% protein, 32.81±2.51% to 46.48±4.93% fat, 26.74±5.14% to 37.07±2.92% carbohydrates and 2.77% to 2.92% ash. Sensory analysis was showed overall good acceptability for all the peanut butter samples but samples from ANKGN3 was showed higher preference than others. According to the stability analysis, butter samples made from the large seeded variety ANKGN3 show higher stability than peanut butter samples made from Tissa and ANKGN4 during the storage period. Therefore the ANKGN3 was the most suitable peanut variety for the peanut butter production.

Keywords: *Peanut butter, Peanut varieties, Storage stabili*

FORMULATION OF HEALTHY COOKING OIL USING COCONUT OIL AND RICE BRAN OIL

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Cooking oil is a common source of dietary fats, which is used as a food processing medium. None of the naturally available vegetable oils does not contain perfect fatty acid profile for good health. Most of the vegetable oils are scarce in essential fatty acid omega-3. Linolenic acid is very important for lipid metabolism and preventing cancers. The ratio between omega-6 and omega -3 is very vital, the unbalance in the ratio may cause aging, cancer, atherosclerosis, obesity and diabetes. In Sri Lanka, major consumable cooking oil is coconut oil. Coconut oil contains high amount of saturated fatty acids (80%-90%). Therefore, excess consumption could lead to an increase in cardiovascular diseases risk factors including LDL, cholesterol and apolipoprotein B (Apo B). It could also increase inflammation, cancers, and neurological disorders. The objective of this study was to develop a blended cooking oil which satisfies the WHO recommendations (the ratio of saturated, monounsaturated and polyunsaturated fatty acids should be 1:1.5:1, the ratio of essential fatty acids, linoleic acid (omega- 6): linolenic acid (omega - 3) should be 5-10:1 and presence of antioxidants) for healthy oil. Commonly used natural cooking oils were tested for identify best fatty acids compositions for prepare healthy blended cooking oil and a healthy cooking oil was formulated using coconut oil and rice bran oil. The fatty acids compositions were tested using Gas Chromatography-Flame Ionization Detector (GC-FID).Among four ratios of prepaid blended oil using coconut oil and rice bran oil, only one ratio (coconut oil: rice bran oil;1:4) was compatible with two WHO recommendations(the ratio of saturated, monounsaturated and polyunsaturated fatty acids should be 1:1.5:1 and presence of antioxidants).Since both of these cooking oils can be manufactured in Sri Lanka, this blended oil will be good source to introduce the general public to reduce non-communicable diseases.

Keywords: *Dietary fats, fatty acid profile, gas chromatography, blended oil, formulating*

KNOWLEDGE, ATTITIUDE AND PRACTICES REGARDING SALT CONSUMPTION AND DAILY SALT INTAKE OF FAMILIES OF SELECTED UNDERGRADUATE STUDENTS

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Salt is important for flavor enhancement and food preservation, but high salt intake will lead to health problems like hypertension and cardiovascular disease. The World Health Organization (WHO) recommends the daily salt intake for adults to be less than 2,000 mg of sodium, equivalent to 5 g of salt per day. The objective of this study was to find out the average daily salt intake among the undergraduate students and their families. Further, the knowledge, attitude and practices related to salt consumption were assessed. Online based questionnaire was used to collect data and 24-hr recall was used to estimate the average daily salt intake. Majority of the respondents were female (71.1%). Determined average daily salt intake per person per day is 7.59±2.17g. The difference between values of daily requirement (5 g) and mean consumption of salt per person per day (7.59 g) is significant ($p \leq 0.001$) with the mean difference of 2.17 g. According to the survey, 55.7% of respondents were not aware of the Recommended Daily Value (RDV) for salt. Also 90.4% of respondents were aware of the adverse health effects of high salt consumption. These data will be helpful to strengthen the food act and other regulations issued by Ministry of Health and consumer affairs authority.

Keywords: *Health problems, Daily recommended value, Survey, 24-hr recalls*

MICROBIAL QUALITY AND GENETIC ANALYSIS OF *E. coli* FROM BULK MILK IN SOTHERN PROVINCE, SRI LANKA

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The quality of milk is determined by aspects of composition and hygiene. Poor quality milk affects all segments of the dairy industry. Standard Plate Count (SPC) limits for bulk milk to be acceptable at dairy processing plants may decrease to levels much lower than they are now, making it concern for dairy producers to meet these higher standards. Safety and quality of dairy products start at the farm and continue throughout the processing continuum. To meet increased bulk milk quality standards, producers must adopt production practices that reduce mastitis and reduce bacterial contamination of bulk tank milk. Use of effective management strategies to minimize contamination of bulk milk and proven mastitis control strategies will help dairy producers achieve these important goals. Thirty raw milk samples were randomly collected from different farms in Southern Province Sri Lanka for the identification of *E. coli* and Coliform contaminations. All the samples were inoculated on different agar media including Nutrient agar and Brilliance *E. coli*/Coliform Selective agar using spread plate method. The viability of bacteria in milk was assessed by using colony forming unit (CFU) on plate count agar. To identify genetic characteristics of selected *E. coli* present in bulk milk samples conventional PCR was used. The results revealed that out of 30 bulk milk samples, 2 samples (6.67%) showed growth of *E. coli*. Among 30 bulk milk, 26 samples (86.67%) showed growth of Coliform count more than 10,000 cfu/mL. The highest rate of Coliform count 2.81×10^6 and *E. coli* count 1×10^4 of contamination was and from the same sample. All bulk milk samples revealed total bacterial count more than 100,000 cfu/mL. Thus, the results of the present study warn of the need for more strict preventive measures. For this, regular sterilization of dairy equipment, washing of utensils, milker's hands, and udders, eradication of diseased animals, and pasteurization /boiling of milk is required before collection and distribution for consumption and product making. In this respect, immediate cooling to 5°C and/ or pasteurization of milk could be more effective.

Keywords: *Total Bacterial Count, Colony Forming Unit, Coliform count, PCR, Hygiene*

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A CASE STUDY ON THE SEASONAL FLUCTUATIONS OF PRODUCTION CAPACITIES AND FACTORS CAUSING NON-PRODUCTIVE HOURS AT BRANDIX ESSENTIALS DURING THE FINANCIAL YEAR 2018-2021 WITH REFERENCE TO THE COVID-19 PANDEMIC

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The textile industry makes a major contribution to the country's economy; in terms of export, industrial production, foreign exchange, and employment. Therefore, it is essential to address the shortcomings of the apparel industry to boost output and thus increase the inflows in the country. Brandix being one of the leading apparel manufacturing companies based in Sri Lanka plays an important role in the Sri Lankan economy as the country's largest contributor to the gross domestic product. The apparel industry, which contributes significantly to gross domestic product, experienced an unfavourable period in history, as most apparel markets were severely impacted by the spread of Covid-19. Most stores worldwide were closed, and many orders were cancelled. Due to all of these setbacks, the Sri Lankan apparel industry was seriously impacted, and production fell precipitously. As a result, the main objective of this research was to identify the factors affecting the productivity of the apparel industry and to identify the patterns in the production capacity allocation with reference to the Covid-19 period. The population of this study includes all of the factories within Brandix Apparel Solutions Limited - Essentials, and one factory was chosen at random as the sample of the study. Secondary data was reconstructed to support this research to meet its objectives. A descriptive analysis was performed to investigate the non-productive hours caused by Covid-related factors along with the frequently and repetitively occurring factors resulting in lost hours. During this study, it was found that the non-productive hours are mainly caused by the delays in receiving raw materials. And, during the Covid-19 period, absenteeism has become the major reason for the non-productive hours Then, a time series analysis was performed to identify the seasonal patterns in the Actual and Planned capacities. Consequently, two models were identified as the best fit model for each variable using the autocorrelation function, partial autocorrelation function, Augmented Dickey-Fuller test, Box Ljung test, Shapiro test and Akaike's Information Criterion value. Thereby, the best fit model for the actual capacity data was determined to be ARIMA(0,0,1)(0,1,0)12, and the best fit model for the planned capacity data was ARIMA(1,0,0)(1,0,0)12. And forecasts were made using those models. Using these models, forecasted capacities were plotted.

Keywords: *Production Capacity, Non-Productive Hours, Apparel Industry, Time Series, ARIMA*

ANALYSIS OF SUSTAINABILITY INDICATORS OF EMJAY INTERNATIONAL PVT LTD

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Emjay International (Pvt) Ltd takes pride in its people, as their commitment & passion, have enabled the company to evolve and grow to become a market leader. Their corporate vision and mission have been a strategic guide, to constantly innovate, and create customer value and delight. Emjay International has four manufacturing facilities in Kurunegala and Kandy Districts, which provide direct employment to approximately 4,000 employees. As a responsible organization, Emjay International (Pvt) Ltd focuses on a proactive way of managing and identifying business affects employees, customers, and local communities. Emjay's social sustainability strategy is a part of the organization's core business strategy. Under the framework of the "Athwela" project, Emjay International will keep up its corporate social responsibility initiatives targeted at supporting the community. The main objective of this study is to examine the primary sustainability metrics and the direction of the Emjay group towards its annual sustainability targets. Time series analysis was done using past year data of Emjay Sustainability indicators and predicted and plotted the future values. According to the fitted ARIMA model for energy consumption, there is an 18.4% percent increase in energy consumption in 2022, compared to the previous year while Emjay has a 15% reduction target to be achieved at the end of this year. According to the fitted ARIMA model for water consumption for the Emjay group, there is a 15% percent increase in water consumption in 2022, compared to the previous year while Emjay has a 20% reduction target to be achieved at the end of this year. According to the fitted ARIMA model for solid waste for the Emjay group, there is a 15% percent increase in solid waste generation in 2022, compared to the previous year while Emjay has a 35% reduction target to be achieved at the end of this year. Therefore, Emjay should focus on engaging in more effective sustainability strategies to achieve its sustainability targets in the coming years.

Keywords: *Key sustainability indicators, ARIMA, Sustainability strategies, Forecasting*

AN INVESTIGATION OF CUSTOMER PROFITABILITY: APPLICATION OF QUANTITY OPTIMIZATION USING LINEAR PROGRAMMING

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Production planning is most important thing to ensure proper execution of production at the right time and on-time delivery/shipment in an apparel industry. Planning performs an impartial role in structuring the available resources to enhance business growth and customer satisfaction. Every business aims to earn a profit. Strategies for maximizing profits involve obvious, focused attention to the process of making profits as possible. Therefore, studying about the most profitable customer in the company is an essential part of the way of maximizing the revenue of the company. This study was done focusing on finding the most profitable customer and optimization of the quantity of pieces to maximize the revenue of the company using Linear Programming. When studying the first objective, the most essential factors that affect the profitability of the customers are efficiency, total cost and total revenue. These three variables were calculated by using the collected data of variables achieved quantity, produced hours and clocked hours for twelve months from February 2021 to January 2022. Then, these calculated variables were ranked and got an average rate for that, resulting Pink Brief the most profitable customer. In the second objective, optimization of the quantity of pieces to maximize the revenue of the company was carried out by using Linear Programming for the month of May-2022. Excel solver was used to analyze the data. As the result, the revenue was higher by USD 38,295 more than the actual revenue for the month of May. As well as it showed the number of pieces that should produce can decrease by 58,039 more than actual pieces for the month even though the revenue increased. The sensitivity analysis showed that, if the capacity of standard minutes of Yamamay customer is increased up to 19562, there is a possibility to increase the revenue of the company more than increasing the capacity of other customers. It was recommended that the company should continue using linear programming in determining the number of each product for each customer to be produced for customers while minimizing the overall supply cost.

Keywords*: Profitability, Revenue, Quantity, Linear Programming, Cus*

CAUSAL RELATIONSHIP ANALYSIS BETWEEN FUEL CONSUMPTION AND ECONOMIC GROWTH IN SRI LANKA

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Using a three-step modern time-series technique, this study investigates the causal relationship between diesel consumption and petrol consumption and economic growth in Sri Lanka. On annual data from 1998 to 2018. Tests for unit roots such as Augmented Dickey Fuller test results cross checked with Phillips-Perron test, auto regression distributed lag cointegration technique, and Granger-causality have been used. The study's empirical findings show that there is a long-run equilibrium relationship between petrol consumption use and real economic growth. In the long run, with the absence of changes in real GDP and diesel consumption, the deviation of the model from the long-run path is corrected by a 73 percent increase in petrol consumption annually at the 5 per cent level of significance. The overall results demonstrate unidirectional causality in the both long-run and short run running from economic growth to petrol consumption. In other words, deviation from the long-run model takes approximately 16 months to eliminate the disequilibrium. As a result, Sri Lanka's energy policy is more open towards sustainable energy solutions replacing petroleum product consumption without hindering economic growth.

Keywords: *Economic growth; Diesel consumption; petrol consumption; ARDL bounds test; error correction model*

DETERMINANTS OF EMPLOYEE MOTIVATION IN THE SHARED SERVICES TRAVEL SECTOR IN SRI LANKA

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Travel industry is a major economic contributor worldwide as well as domestically. Therefore, it creates the importance to go through the factors which determines the success of a travel company internally specially that of the employees. The current study was designed with the intention of analyzing the determinants of employee motivation in the shared services travel sector with special reference to a shared services travel company in Sri Lanka. A survey containing questions of Likert scale was shared among the employees and 84 responses were gathered. After a descriptive analysis and a correlation analysis to understand the behavior of the considered variables, a multiple linear regression model was fitted. Out of the 04 considered independent variables namely financial rewards, non-financial rewards, working environment and the human relationships, only financial rewards and non-financial rewards were identified as having a significant positive relationship with the dependent variable, employee motivation. This implies that the companies of the shared services travel industry should focus on improving the financial benefits such as wages, salaries, incentives, increments as well as non-financial benefits like, promotions, recognitions, employee achievements in order to keep the employee momentum at work and to give out their maximum.

Keywords: *Employee motivation, travel industry, financial rewards, non-financial rewards, working environment*

DEVELOPMENT OF INVENTORY MANAGEMENT SYSTEM FOR MONITORING EFFICIENCY

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This study is aimed at developing a web-based application named stock management system for managing the inventory level of this selected company. The web-based system refers to the system and processes to manage the inventory of the company with the involvement of technology. With the prevailing system of the company lot of inefficiencies are created as the employees must do manual checking of stock that duplicates the workload. The main objective of the system development reflects to deduct inefficiencies and improve work time effectiveness. The system developed, can be used to store the details of the inventory, stock maintenance, update the inventory based on the sales details, and generate sales and inventory reports on a daily weekly, or monthly basis. Most importantly system ensures that data are real-time updated. Without proper inventory control, a company may run out of stock on an important item which might be a critical issue and this system alerts the admin on the time to reorder. Hence, this automated stock management system helps to minimize errors while recording and reordering the products at the proper time. The statistical analysis carried out as a comparison between before and after the situation of developing the web-based system concludes that the average number of orders handled per day and employee satisfaction level have been improved.

Keywords: *Inventory management, Web-based, Efficiency, Real-time, Employee satisfaction*

FACTORS INFLUENCING THE HOUSEHOLD SAVING PATTERNS DURING COVID 19 PANDEMIC: CASE STUDY CONDUCTED IN WESTERN PROVINCE, OF SRI LANKA

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Covid 19 pandemic forced governments around the world to take control measures to minimize the spread of the disease. Those control measures caused an economic instability. In order to survive through economic hardships people around the world changed their consumption and saving behaviors. First objective of this study is to understand reasons behind the change in saving behavior of individuals in Western province, Sri Lanka during the pandemic. The second objective of this study is to provide useful insights for the authorities for economic recovery. Hypothesis were build and used an online questionnaire to collect data. Convenience sampling was used and data were collected from 100 individuals. Data were tested for normality, validity and reliability. Then weak indicators were removed before analyzing the data. Regression analysis was used for hypothesis testing. This study analyze how materialism, risk perception, severity of the pandemic affects the individual's willingness to save. Positive relationship was identified in between household's willingness to save and severity of the pandemic. Risk perception was identified as the mediator in the relationship between willingness to save and severity of the pandemic. It was found that materialism do not moderate the relationship between willingness to save and risk perception. According to the results it was found that households tend to save during public health emergencies and risk perception stimulate people to save more. Therefore, authorities can encourage people to spend more during the pandemic by using methods such as providing subsidies, issuing coupons, etc. Since risk perception can stimulate saving by providing accurate and reliable information sources people can have a better understanding of the real risk that they are in. Through that authorities can encourage people to spend money and circulate more money in the economy. Thereby, faster economic recovery can be obtained.

Keywords*: hypothesis, willingness to save, risk perception, materialism, severity of the pandemic*.

FOREST HARVESTING RESIDUE AS AN ALTERNATIVE ENERGY SOURCE – A CASE STUDY FOR *PINUS CARIBAEA* IN SRI LANKA

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To protect our environment from further deterioration and to meet the rising and unstoppable need for energy in the developing globe, it is imperative that we look into and use alternative energy sources. Thus, the objective of this study was to evaluate the potential of *Pinus caribaea* forest harvesting use as alternative energy by analyzing their combustion properties. *Pinus caribaea* harvested residues from Wawathanna plantation in Pahanthibukanda FA division (WPP) and Aspanthiya plantation in Hewahata FA division (APH) belonging to the Department of Forest conservation were selected for the study. In the selected plantations 20m×20m plots were laid and tree Diameter Breast Height (DBH) and tree height were measured of 34 trees in APH and 32 trees in WPP. Further to that green biomass of leaves (needles) with twigs and branches were weighted from the sampled trees. Then tree volume of each tree was estimated using fitted Schumacher and Hall's volume model for *Pinus caribaea*. Each type of residue was characterized and analyzed for moisture content, volatile matter content, ash content, fixed carbon, and calorific value by following the American Society for Testing and Material (ASTM). According to the results, Pine needles and branches were found to be excellent biomass for the production of heat since the moisture content of 10.29% and 11.55% respectively. The ideal conditions for producing energy from pine needles and branches, as well as the volatile matter content of each residue was 77.62% and 85.08% respectively. The highest heat value was shown by Pine needles over the branches. The calorific value was reported as 21.61MJkg^{-1} and 20.92MJkg^{-1} for leaves and branches respectively. According to the dry biomass from branch residues in the studied plantation 1957275.2MJ/ha can be produced. At the same time, 2292604.9MJ/ha can be produced by using leave (needles) residues. The Cabinet resolved in November 2017 to transform the Pine plantation in Sri Lanka into a plantation of local plant species. In Sri Lanka's wet and intermediate zones without protected forest areas, there are roughly 16,000 hectares of Pine plantations that are going to be replaced with local tree species. Thus, 6.8×10^{10} MJ of total energy can be generated from the entire harvested *Pinus caribaea* residue on the island and can be directly utilized for commercial purposes.

Keywords: *Pinus caribeae, Alternative energy, Biomass, Harvesting residue, Calorific value*

IDENTIFYING FEASIBLE STRATEGIES TO REDUCE ORGANIZATIONAL CARBON FOOTPRINT: A CASE STUDY FOR STATIONERY INDUSTRY

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The impact of greenhouse gas (GHG) emissions in stationery industry of Sri Lanka has long been controversial topic, hampered in part by lack of adequate evidence. The present study therefore aimed to perform an organizational carbon footprint assessment for ABC (Pvt) Ltd. to identify the hotspots of GHG emissions and rank the importance of potential carbon footprint reduction strategies of the industry. A unique research methodology was developed to estimate GHG emissions from ABC (Pvt) Ltd as per ISO 14064-1 standard. Subsequently, a combination of potential carbon footprint reduction strategies was ranked using analytical hierarchy process (AHP). For the carbon footprint assessment, data were gathered from the organization's data base, interviews and questionnaire surveys. Factory visits, expert opinions and literature were used to develop carbon footprint reduction strategies. For the AHP analysis, data were gathered from experts by using guided questionnaire. The total carbon footprint was estimated as 9,143.7374 tCO_2e/year. Importing of material (49%), consumption of purchased electricity (32%) and employee commuting (13%) were identified as hotspots of GHG emissions. Developed carbon footprint reduction strategies were then ranked using AHP under six criteria which were initial cost, maintenance cost, environmental benefits, social acceptance by employees, social acceptance by public and post implementation functionality. Sourcing materials locally was ranked as number one while carbon offsetting, changing suppliers to a near country and Reduce - Reuse - Recycle (3R) were ranked as second, third and fourth on their importance of reducing carbon footprint from importing of materials. Switching to energy efficient appliances and equipment was the most important strategy for carbon footprint reduction from consumption of purchased electricity while installing solar panels, modifying buildings with skylights and natural ventilation and establishing reward system for employees on good housekeeping practices were ranked as second, third and fourth based on their AHP scores. Providing accommodation for employees was ranked as number one while expanding the company transport service, carbon offsetting and carpooling by three-wheelers/motorbikes were ranked as second, third and fourth on their importance of reducing carbon footprint from employee commuting. As reducing carbon footprint of industries is critical to control global warming, the results of this study can be employed as a framework for decision making in reducing organizational carbon footprint to achieve sustainability in stationery industry.

Keywords: *Carbon footprint, Greenhouse gases, Stationery industry, Analytical Hierarchy Process*

IMPACT OF FOREST STEWARDSHIP COUNCIL CERTIFICATION ON SELECTED ECOSYSTEM SERVICES OF RUBBER PLANTATION SECTOR: A CASE STUDY

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Ecosystems are beneficial in various ways for the existence of the nearby communities because they offer products and services which are beneficial to humans. Since people continuously rely on the environment, the ability of the ecosystems to provide those services under pressure. Ecosystem services (ESS) are categorized into various forms such as provisioning services, regulating services, supporting services, and cultural services. Forest Certification (FC) created a system to demonstrate and communicate about the positive impacts of responsible forest management on ecosystem services. In Forest Stewardship Council certified forests and plantations, essential ecosystem services are protected than that of non-certified entities. The majority of agricultural plantations in Sri Lanka produce rubberwood (*Hevea brasiliensis*), for latex and timber. A few companies that manage rubber plantations in Sri Lanka have also been certified. Therefore, this study aimed at evaluation of provisioning services provided by the FSC-certified and non-certified rubber estates to assess the importance to the local people in setting the conservation priorities and determine the impact of the FSC certification. For these reasons, a questionnaire survey was conducted for the 15 workers and the 5community as stakeholders in Pussellawa Plantation Limited for certified (Ayr, Elston, Halpe, Penrith, Salawa) and non-certified rubber estate (Siriniwasa) to identify common ecosystem services. It revealed that Halpe estate among certified five estates has the common ecosystem services with non-certified Siriniwasa estate. Therefore, it was selected to compare against the non-certified Siriniwasa estate. In order to quantify of the ecosystem services, another questionnaire survey was conducted for 15 workers 15 community and 10 persons in management. Then the economic values of provisioning services were analyzed and their contribution to the livelihood of local stakeholders was evaluated, using a direct market valuation technique and measurements which included and collection of market prices, Results revealed that FSC-certified rubber estates provide a greater variety and economic value of provisioning services (Rs. 399.44 per year/ha/capita) were more valuable than those provided non-certified estate (Rs. 266.10 per year/ha/capita). Overall, Forest Certification has a positive impact on the provisioning services into the FSC-certified rubber estate.

Keywords*: ecosystem services, forest certification, provisioning services, economic value, direct market valuation technique.*

SHORT-RUN AND LONG-RUN ELASTICITIES OF KEROSENE DEMAND IN SRI LANKA

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This study is designed to identify the impact of key economic variables on kerosene demand in SL by estimating the elasticity of demand. Furthermore, the real price of kerosene which represents the price, real gross domestic product per capita which represents the income, and price of liquid petroleum gas which represent the price of substitute are considered economic variables in this study. Price elasticity, income elasticity, and cross elasticity in the short run and long run are estimated for the period 1990-2020 by using Johansen co-integration procedure and the vector error correction model. The results of the study revealed that while price and income have a significant impact on kerosene demand in the short and long term, liquid petroleum gas price does not. Therefore, it is concluded that liquid petroleum gas is not a good substitute for kerosene. Accordingly, long run price elasticity and income elasticity are -0.52 and -0.345 respectively. Moreover, short run price elasticity and income elasticity are 0.35 and 0.30 respectively. Furthermore, the error correction term (-1.45) implied that it takes approximately a period of two-thirds of the year (eight months) to remove the disequilibrium. Hence, long run period represents the approximate period of two-thirds of the year. Finally, it can be concluded that there is a positive relationship between price, income, and demand in the short run and a negative relationship in the long run. Since price inelasticity of kerosene demand shows that people who used to use kerosene for their purposes are completely dependable on kerosene, it has become an essential good for people who used it. Therefore, subsidy on kerosene should be continued for survival in terms of energy for the target group. Negative income inelasticity of kerosene demand in long run indicates that kerosene is an inferior product in the long run and people tend to move to substitutes with increasing income. Therefore, subsidy on kerosene is not completely wasted due to the grabbing subsidy by higher income groups. Since demand would be declining with rising income per capita, prediction of future kerosene demand should be considered about the per capita income. Since the price of liquid petroleum gas did not significantly influence the kerosene demand, insignificant cross elasticity revealed that liquid petroleum gas is not a good subsidy for kerosene. Therefore, there should be another substitute for kerosene However, this study considered the only price of liquid petroleum gas due to previous suggestions and data unavailability for diesel and electricity. Therefore, future research works should consider other substitutes for kerosene demand studies.

Keywords: *Elasticity of demand, Co-integration, Vector error correction model, Kerosene*

WATER FOOTPRINT ASSESSMENT AT THE SELECTED DAIRY PRODUCTION UNITS: A COMPARATIVE STUDY BASED ON ISO 14046

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Dairy production requires a tremendous amount of fresh water to operate its processes. The study has been carried out at a leading dairy processing plant in Sri Lanka which produces various dairy products, including ice cream, yoghurt and UHT milk. The facility consumes and pollutes a significant volume of freshwater during its production process. The water footprint is a multidimensional indicator and shows quantities of water consumed and polluted. The study's main objectives are to assess the water footprints of ice cream, yoghurt and UHT milk units separately to study them comparatively, identify primary water consumption and pollution hotspots, and identify opportunities for water-use reduction. The study is guided by ISO 14046:2014, an international standard. The research boundary has extended from the supply chain inputs that have already been transported into the plant to the finished products at the production plant. Production units of ice cream, yoghurt and UHT milk were clearly defined. The footprint of a process step is considered the summation of its supply chain and operational water footprints. A total of 48 water footprints were calculated considering 1L of processed fresh milk as the functional unit representing 12 months of 2021. Obtained footprints were analyzed descriptively and graphically. A focused group interview has been carried out with six experts in the field to make a recommendation for the water use reduction of water footprint and identify hotspots. The results of the comparative study conclude that the ice cream production unit has a significantly higher water footprint variation than the yoghurt and UHT units. Yoghurt and UHT production units show almost an equal variation of water footprints. The mean water footprint values of ice cream, yoghurt and UHT milk production units are 60009.28 L, 8854.91 L and 7225.51 L, respectively. The green water footprint's significant contribution to the total water footprint varies from 78% to 91%. The yoghurt production unit generates the highest grey water footprint percentage which is nearly 14% of its total water footprint. The blue water footprint percentage of the UHT milk unit is 9% and is higher than the other units. The crop-related raw materials have higher virtual water volumes contributing 41%-51% of the total water footprints. Hence, the industries should consider the water footprints of their operations and supply chain inputs to reduce water footprints.

Keywords: *Water Footprint, ISO 14046 standard, Comparative assessment, Dairy production units, Water use reduction*

WATER HYACINTH (*Eichhornia crassipes*) AS A POSSIBLE ALTERNATIVE ENERGY SOURCE: A CASE STUDY FOR INSEE CEMENT MANUFACTURING PLANT IN PUTTALAM, SRI LANKA

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The production process in cement manufacturing plants is typically energy-intensive and currently using alternative fuels partially or totally to replace fossil fuels to reduce the energy and environmental costs. Among the different types of alternative fuels, biomass is one of the main alternative fuel used by the industry which has the potential to replace up to 20% of total energy demand. Water hyacinth (WH) is a problematic invasive alien species in aquatic ecosystems of all climatic zones in Sri Lanka. Therefore, WH could have the potential to be used as biomass energy owing to non-edible, rapid growth, and freely available in larger quantities. Thus, this study aimed to elucidate the potential of WH biomass as an alternative energy source for the INSEE cement plant in Puttalam. The study was conducted in three selected reservoirs namely, Tabbowa reservoir (TR), Murukkuwatawana reservoir (MR), and Nawadankulama reservoir (NR) located in Puttalam district Northwestern province of Sri Lanka. Using the Google Earth satellite images,WH covered areas of the selected reservoirs were calculated. WH samples from each reservoir were collected for analyzing biomass, and to determine the fuel characteristics such as net calorific value (NCV), Chlorine, and Sulfur content, moisture, volatile matter, fixed carbon, and ash content. According to the results, the fresh WH biomass was recorded as 692.62, 389.85, 23.58 tons in 2020 and 3570.82, 584.53, 33.31 tons in 2021 in the TR, MR, and NR respectively, while the dry WH biomass was recorded as 41.65, 24.65, 1.31 tons in 2020 and 214.74, 36.96, 1.85 tons in 2021 in the TR, MR, and NR respectively. Volatile matter content was the predominant component of WH biomass. Except fixed carbon content, ash, and volatile matter content were not significantly different among WH in studied reservoirs. NCV of the WH composite sample was 12.02 MJ/kg. Moisture content, ash content, chlorine and sulfur content were recorded as 13.56%, 10.95%, 1.06%, 0.14% respectively. Except for chlorine content, other parameters agreed with the acceptable limits for using WH as an alternative energy source for cement industry. Since relatively large quantities are freely available and with high volatile content and calorific value, WH is suitable as an alternative energy source. However, economic feasibility should be studied prior to the commercial application.

Keywords: *Alternative fuel, Biomass, Water hyacinth, Calorific value, Cement Industry*

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CUSTOMER PURCHASING INTENTION OF EMERGING MARKETS: SPECIAL REFERENCE TO THE STATUS OF THE FLORICULTURE INDUSTRY IN SRI LANKA

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Floriculture is the branch of ornamental horticulture that focuses on cultivating flowers, and other decorative plants, their marketing and floral arrangement. The industry personnel have observed reduced sales for floriculture-related products in the past few years. So, this study is looking to understand the industry's status better and increase customer purchases in the future. This study investigates the impact of social media marketing and customer knowledge on customer purchasing intention. In addition, the key issues, challenges, and opportunities in the Sri Lankan floriculture industry. Regression analysis and thematic analysis were used as tools for data analysis in this study. The outcome of the study interpreted that social media marketing had an impact on customer purchasing intention. In contrast, customer knowledge and demographic factors like age, gender, residential area and average monthly income did not impact it. Nevertheless, during the covid-19 period, customer knowledge has impacted it. The fertiliser issue, fuel scarcity and the economic crisis in the country were recognized as the main barriers to the industry's current downfall. In conclusion, marketing floriculture products through social media can increase sales and solutions for current issues like fertilizer issues, fuel scarcity, and economic crisis in the country, leading to the industry's upliftment.

Keywords: *Floriculture, Purchase intention, Consumer knowledge, COVID-19, Social media marketing*

DETERMINANTS OF SRI LANKAN E-GROCERY ADOPTION DURING COVID – 19 PANDEMICS IN COLOMBO DISTRIC, SRI LANKA

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The expansion of e-grocery services in Sri Lanka has been accelerated by the rising number of e-grocery start-ups and the COVID19 pandemic. Compared to other e-commerce product categories like fashion and electronics, e-grocery penetration is quite low. Before deciding to purchase for groceries online, customers take into account a number of aspects, including trust, risk, benefit (usefulness), and the level of ease of use. The goal of this study is to ascertain whether all these variables have an impact on customer trust, adoption of grocery shopping online, and whether Indonesian Sri Lankan consumers will go back to offline food shopping following the COVID19 epidemic. By using the Technology Acceptance Model Approach and using trust as an intermediary variable, this study offered a fresh viewpoint. By delivering questionnaires to 200 respondents who had utilized e-grocery/online shopping services, quantitative research was carried out. The PLS-SEM (Partial Least Square - Structural Equation Model) was used to analyze the data collection. According to the study's findings, trust is positively impacted by perceived dangers, perceived usefulness, and considered ease of use. According to the study, Sri Lankan consumers' use of the e-grocery platform was significantly influenced by their level of trust. Even when the COVID-19 epidemic is over, the e-grocery platform should provide its clients with new and reliable goods and services, especially for the elderly generation who like to shop at traditional markets.

***Keywords**: Perceived Risk, Perceived Ease of Use, Perceived Usefulness; Trust, E-grocery Adoption.*

EXPLORING GREEN MARKETING MIX IMPACT ON CUSTOMER PURCHASE INTENTION IN EMERGING INDUSTRIES IN SRI LANKA: SPECIAL REFERENCE TO SOUTHERN PROVINCE

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Quite a number of studies discussed the green marketing over the years; however, few studies on the association in between green marketing mix and customer purchase intention in Sri Lanka. The current study's main intention is to investigate the impact of green marketing mix (product, price, place and promotion) on customer purchase intention in the long term or short term of selected three emerging industries in Sri Lanka. Further, it is aimed to test the moderate impact of environmental knowledge on the relationship between green marketing mix and customer purchase intention. Herbal cosmetic industry, Solar panel industry and Tourism hotel industry are selected as emerging industries in Sri Lanka. The main objective of the study is to investigate the impact of green marketing mix on customers purchase intention in the long term or short-term of the emerging industries. The main objective can be divided into three specific objectives, such as to examine the impact of green marketing mix on customer purchase intention in the short term/ long term of the emerging industries, and to examine the impact of environmental knowledge as moderator on the relationship between green marketing mix and customer purchase intention. The design of this study is descriptive and quantitative in nature. Target population of this study is customers in the Southern province. Primary data were collected from 100 respondents from the Southern province through questionnaires. Secondary data were obtained from research articles, academic journals and websites. Correlation values of the herbal cosmetic industry, tourism hotel industry and solar panel industry are +0.244, +0.445, +0.436 respectively. There is a positive weak relationship between the customer purchase intention and green marketing mix in the herbal cosmetic industry. Tourism hotel industry and solar panel industry has a positive moderate relationship. Customer purchase intention and green marketing mix was statistically significant as the p value is $P>0.05$ for all three industries. Multiple regressions revealed that there is significant effect of green marketing mix elements on the consumer's purchase intention in the three industries. Moreover, the environmental knowledge moderates the relationship that exists between green marketing mix and purchase intention. This study focuses only on four dimensions of green marketing mix, future studies can be conducted on seven dimensions of green marketing mix. Studies can be focused on different industries as well.

Keywords: *Green Marketing Mix, Purchase Intention, Cosmetic, Tourism, Solar*

FACTORS AFFECTING EMPLOYEE ENGAGEMENT: A STUDY OF THE NATIONAL AGRICULTURE RESEARCH SYSTEM OF SRI LANKA

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Employee engagement is one of the key factors that determine the organizational success. It is determined by several factors. This study focused at the National Agriculture Research System (NARS) in Sri Lanka which consists of fourteen main Research and Development Institutes. When considering the organization, employee performance and employee retention are at satisfactory level while absenteeism and employee turnover are low. In order to make a better organization, researcher thought to identify the factors affecting employee engagement within the organization. Therefore, the main objective of this study was to identify the factors affecting employee engagement while four main factors; workplace spirituality, leadership, work-life balance and rewards were identified as possible factors. The study was based on a quantitative approach. It was carried out to test formulated hypotheses. The study was a correlational investigation with the minimum interference of the researcher. The target population was all the employees who are working at NARS while the sample was 80 random employees. A self-administered questionnaire with a five-point Likert scale was used as the study instrument. Data was analyzed using IBM Statistical Package for Social Sciences (SPSS) Software. The obtained results revealed a positive relationship between all four independent variables (workplace spirituality, leadership, work-life balance and rewards) and the dependent variable (employee engagement). Hence, it was concluded that there is an impact of workplace spirituality, leadership, work-life balance and rewards independently on the engagement of employees who are working at main Research and Development Institutes under National Agriculture Research System (NARS). Based on the results obtained from the study, research recommends promoting motivational programs, positive mindset, meditation and yoga in order to ensure the overall wellbeing of the employees, building trust among leaders and employees, getting the employees involved in decision making processes, appreciating thoughts and suggestions from the employees and effective listening for great leadership practices, offering flexible working hours and remote working facilities due to the current crisis, encouraging leave for an improved work-life balance and proper rewarding systems to encourage higher employee engagement.

***Keywords**: Employee engagement, Workplace Spirituality, Leadership, Work-Life Balance, Rewards*

FACTORS AFFECTING ORGANIZATIONAL COMMITMENT: A STUDY OF ABC COMPANY LTD

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Organizational commitment explains individual's intention to stay in the current organization and employing effectively and positively for the organization. Organizational commitment of employee is one of the key requirements which affects to achieve organizational success. Even though many studies have been conducted about organizational commitment, there is no such study specially regarding the Sri Lankan coconut-based manufacturing and exporting sector. Therefore, this study focuses on identifying factors which affects and its impacts on organizational commitment of employees at ABC company Limited as a Sri Lankan organization which involves in manufacturing and exporting coconut kernel-based products. Moreover, identifying the impacts of work-life balance, leadership, rewards and trust on organizational commitment is the second specific objective of this study. Here, organizational commitment was dependent variable and factors namely rewards, trust, leadership and work-life balance were considered as independent variables. Work-life balance explains how individual is equally engage in and satisfied with his/her work role and family role. The concept trust in this study is about extent to which a person is confident and willing to act on words and decisions of another. Here, rewards are benefits that employee perceived for their participation in organization. In organizational context, leadership relevant for influencing people to achieve organizational goals and objectives. This is a quantitative and cross – sectional type study. Due to being a population gap, the data was gathered through close-ended structured questionnaire from randomly selected 120 blue collar and first level supervisor type employees covering all departments of the organization. The main idea of this study was hypothesis testing. Then four hypotheses were constructed assuming there is an impact of each independent variable on organizational commitment. Collected data were analyzed for both inferential and descriptive statistics by using IBM SPSS. The results reveled that Work-life balance, Leadership, Rewards and Trust are significant positive factors which increase the organizational commitment. ($p<0.01$). Hence null hypotheses were rejected, and alternative hypotheses were not rejected. Furthermore, regression analysis revealed that trust and work-life balance are statistically significant predictors of organizational commitment. These findings will be helpful for especially Sri Lankan medium and large-scale coconut and other agriculture crops-based manufacturing and exporting organizations to enhance and adjust their strategies towards getting more committed work force for achieving their organizational goals.

Keywords: *Organizational commitment, Rewards, Leadership, Work -Life Balance, Trust*

FACTORS IMPACTING ON THE ENTREPRENEURIAL PERFORMANCE OF WOMEN-OWNED MICRO-SCALE BUSINESSES IN WESTERN PROVINCE, SRI LANKA

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Women entrepreneurs can be simply described as the women who began a business and women who are able to run a business. The Women entrepreneurs are not performing well always and there should be factors impacting on the entrepreneurial performance of them. Those success factors could be differ from country to country, place to place. The purpose of this paper is to investigate the impact of key factors on the performance of women entrepreneurs who owned and managed Micro-Scale Businesses in Western Province, Sri Lanka. The sample size is selected as 100 and the sampling technique is convenient sampling method where the data is collected from a conveniently available pool of respondents. A questionnaire was distributed to women entrepreneurs through social media to collect the data. Cronbach's α test have been carried out to test the reliability of data and validate the hypothesis. The results suggested that the personality traits, motivation, access to market affect positively and significantly to the entrepreneurial performance of women-owned micro scale businesses in Western Province, Sri Lanka. The government support do not have a significant positive impact on entrepreneurial performance. The results indicate that several factors including personality traits, motivation and access to market are linked with the success of women entrepreneurs in Sri Lanka. The results of this study will provide some insights to policymakers and businessmen to formulate policies and strategies in order to promote willingness to start and manage businesses of women entrepreneurs in Sri Lanka. Most of the studies conducted in Sri Lanka have focused and taken into consideration about the obstacles faced by women entrepreneurs. There are only a few studies carried out to find the success factors of women entrepreneurs. Therefore, this study is an attempt to fill the gap and suggest the impacts of selected factors on entrepreneurial success of women entrepreneurs.

Keywords: *Women Entrepreneurship, Entrepreneurial performance, Success Factors, Micro scale Businesses, Small and Medium Enterprises (SME)*

IMPACT OF INVENTORY MANAGEMENT ON FINANCIAL PERFORMANCE OF FOOD, BEVERAGE AND TOBACCO LISTED COMPANIES IN SRI LANKA

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In present era competitive world having business is very important to control various costs to sustain in the market. To sustain in the market, inventory management plays an important role to make a control over the financial statement of the organization. Effective inventory management is effect for the overall performance of the Food, Beverage and Tobacco manufacturing company. The Food, Beverage and Tobacco manufacturing companies retain inventory as Raw materials, Work in Progress and Finished goods mainly and stock value takes a significant percentage of among all assets. Main objective is this report find out the relationship between inventory management and financial performance and find out the impact of inventory management on financial performance in Sri Lankan Food, Beverage and Tobacco manufacturing firms. This study employed a descriptive research design and used quantitative method. All relevant data get from the secondary sources such as annual report and published articles. The target population was Food, Beverage and Tobacco Listed companies in Sri Lanka while sample size was 42% of the target population. The sampling design adopted was be random sampling techniques and Data was analyzed by use of EViews) regression and correlation. Data was then presented using tables and figures. The empirical results revealed a positive relationship between financial performance and Inventory management at 0.05 significance level. The study suggests that owners/managers of food, beverage and tobacco manufacturing firm effective inventory management as a tactic to further their financial performance and in overall financial performance of their organization.

Keywords*: Inventory Management, Economic Order Quantity, Inventory Turnover Ratio, Average Age of Inventory, Financial Performance*

IMPACT OF JOB STRESS DUE TO COVID-19 PANDEMIC ON EMPLOYEE PERFORMANCE IN SOUTHERN PROVINCIAL IRRIGATION DEPARTMENT, SRI LANKA

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This study was conducted to determine the impact of job stress due to covid-19 pandemic on employee performance. The impact of the covid-19 pandemic has negative effects on many industries and organization around the world. Due to changes of people's daily routines increase the stress during the covid-19 pandemic. Job stress is a growing concern as it leads to psychological and physical problems for the employees. Stress could result in a decrease in employee performance. Independent variable of this study is stress. Stress is measured by workload, remote working and workplace isolation. The dependent variable is employee performance. Due to the limited number of employees whole population taken as a sample. The sample size of this study is 40. The sampling technique of this study is the convenience sampling method. Data collected using close-ended questionnaire. The main objective of this study is to examine the impact of job stress due to covid-19 pandemic on employee performance. Bivariate analysis and regression analysis was used to test the research hypothesis. The findings and interpretation revealed a job stress is negatively impact on employee performance. From measured factors remote working is mostly impact on employee performance. Secondly workplace isolation and workload is least impact on employee performance. The study concludes that workload, remote working, and workplace isolation are significant predictors of employee performance in covid-19 pandemic situation in Southern Provincial Irrigation Department, Sri Lanka.

Keywords: *Employee performance, Job stress, Workload, Remote working, Workplace isolation*

IMPACT OF WORK LIFE CONFLICT ON EMPLOYEE JOB SATISFACTION- A STUDY BASED ON STATE SERVICE ORGANIZATION, GALLE DISTRICT IN SRI LANKA

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Many organizations have work life conflict which is based on work life and family. It can categorize in to work family conflict and family work conflict. Further those are directly affect to the employee job satisfaction. It has become a key challenge in many organizations. The study targeted a population of 75 employees and among them 60 samples of respondents were drawn using of the target population and administrating a structured questionnaire, which consisted of 32 questions and statements with 5 points Likert scale. Main Objective of the project is, "To examine the impact of work life conflict on employee job satisfaction of employees at state service organization, Galle". Quantitative data was analyzed using descriptive statistical tools, correlation and regression analysis. Regression analysis results indicate that from the total variation of job satisfaction 80.2% has explained by the work life conflict while 34.7% of the variation is explained by the work family conflict and 78.9% of the variation is explained by the family work conflict. A correlation analysis revealed work life conflict has a negative relationship with job satisfaction. All three hypotheses have accepted according to the result of the tests. As per the results of analysis it is concluded that the management must focus on work life and family life conflict determinant in order to enhance the job satisfaction. Researcher recommended that management should improve work life balance conditions in the work place for that. The key findings of the study show that work life conflict has a negative relationship with job satisfaction of employees at state service organization in Galle in Sri Lanka.

Keywords: *job satisfaction, family work conflict, work family conflict.*

THE IMPACT OF NON-EXECUTIVE LEVEL EMPLOYEES' JOB COMMITMENT ON THEIR JOB PERFORMANCE- A CASE STUDY OF XYZ PUBLIC SECTOR ORGANIZATION

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Committed employees make an enormous contribution to firms due to the fact they behave in ways that help the firm achieve its objectives. So this study was conducted to examine the impact of Employee commitment (Affective commitment, Continuance Commitment) on Job Performance of non-executive level government employees in the XYZ public sector organization, southern province, Sri Lanka. Independent variable of the study is Employee Commitment and dependent variable is Job Performance. The records were collected from a sample of 75 employees. Bivariate analysis and regression analysis were applied to analyze the data with the SPSS 26.0 (Version). The study confirmed that there is an impact of Employee Commitment on Job Performance. And also that the two dimensions of Employee Commitment; Affective Commitment and Continuance Commitment have a positive significant impact on Job Performance. Affective Commitment was found as the maximally affected dimension on Job performance at the organization (0.503). And Continuance commitment was observed as the least affected dimension with a comparatively weak relationship with Job Performance (0.424). The study concluded that Employee Commitment is a remarkable predictor of Employee Job Performance and can be used to enhance the level Job Performance of employees at XYZ Public sector organization. This study is of great value focusing the consideration of top administration and policy makers to implement policies and arrangements to upgrade Job Performance through boosted commitment of employees.

Keywords: *Job Performance, Employee Commitment, Affective Commitment, Continuance Commitment*

INTENTION OF CONSUMERS IN WESTERN PROVINCE SRI LANKA: WITH SPECIAL REFERENCE TO CONSUMER ELECTRONICS INDUSTRY AND COSMETICS AND PERSONAL CARE INDUSTRY

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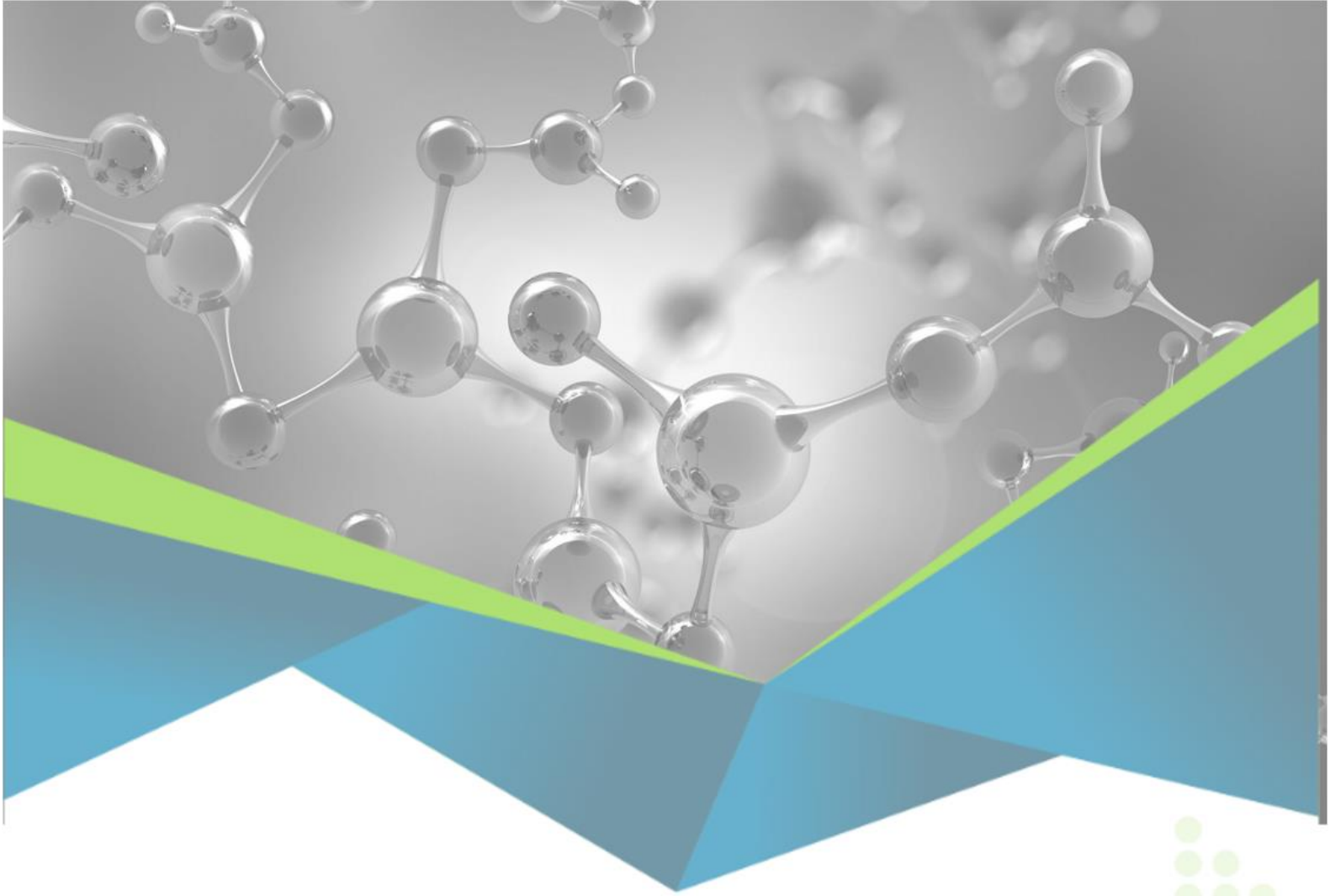
Various marketing tools have emerged related to social media platforms with the rise of social media platforms. One of the latest marketing tools is social media influencer marketing. A social media influencer is an opinion leader who communicates with a mass audience and could change their opinion on a product or a brand through social media updates. Earlier, most companies used celebrity endorsement to improve the effectiveness of their advertisements. Now, companies are abandoning this strategy worldwide due to the popularity of social media platforms and online stores. Social media influencer marketing in Sri Lanka is also getting popular, and the effectiveness of social media influencer marketing is not well analysed. The purpose of this study is to identify the effect of social media influencer endorsement on purchasing intention of consumers. Western province residents were selected as the population. The proposed model in this study was influenced by celebrity endorsement theories (credibility model, source attractiveness model, the TEARS model, the matchup hypothesis). The questionnaire was made by adopting five points Likert scale and it was created as a Google form. To assess the quality of the research, a reliability test was done. To identify whether the population is normally distributed, a normality test was done. To measure the linear relationship between the independent and the dependent variable, a correlation analysis was done. To assess the relationship between the independent and dependent variables, regression analysis was done. For the analysis of the data, IBM SPSS Statistics 25 software was used. According to the correlation results, there is a strong positive relationship (0.724, $P<0.05$) between social media influencer endorsement and purchasing intention with regard to consumer electronics. And there is also a positive relationship (0.668, $P<0.05$) between social media influencer endorsement and purchasing intention with regard to the cosmetics and personal care industry. One of the limitations was the inadequate sample size. Another limitation was the respondents' lack of knowledge of social media influencers. It could have an effect when answering the questionnaire. Marketers can use the findings of this study to develop effective advertisement campaigns which use social media influencers, to communicate with their customers and gain some advantage over their competitors.

Keywords: *Influencer marketing, Purchase intention, Social media*



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COMPARATIVE STUDY OF ALTERNATIVE ORGANIC SOLVENTS FOR GRIP DESIGNING PROCESS OF LATEX COATED GLOVE MANUFACTURE

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An investigation and comparative study of alternative less toxic organic solvents for xylene in the grip designing step of the natural rubber latex-coated glove manufacturing process was carried out. During the grip design step, volatile organic solvents are utilized to form a crinkled surface on the natural rubber latex coating of the supported glove. The toxic nature (Carcinogen) of the currently used solvent (xylene) is the main reason for this exploration. Finding an alternative less toxic solvent instead of xylene is crucial for enhancing the health and safety of workers. The compatible solvents with natural rubber latex were evaluated according to the chemical structure, and thermodynamical compatibilities, and the toxicological study of each selected solvent was carried out by using secondary sources. Acute toxicity parameters such as lethal concentration (LC_{50}), median lethal dose (LD_{50}), and other evidence like exposure limit (PEL and OEL), and carcinogenicity of each selected solvent were comparatively studied. n-heptane, n-hexane, and ethyl acetate were selected as less toxic alternative solvents which can be used instead of xylene for the process. The swelling capability variations of each selected solvent were observed by calculating the swelling percentage values under different maturation levels of LC 601 and LC 606 natural rubber latex types. The crinkle formation of n-hexane and the current solvent was compared with the variation of the mixing ratio of acetic acid and swelling agent under different drying times. Although both aliphatic solvents (n-hexane and n-heptane) showed an optimal degree of toxicity when compared to xylene, their swelling percentage variation of aliphatic substances didn't reach the extent of aromatic substances. However, the application of aliphatic hydrocarbons as the alternative for the grip forming stage has shown an effective and positive response.

***Keywords**: Polymer swelling, swelling agent, acute toxicity, Crinkle formation*

DETERMINATION OF PAINT: HARDENER VOLUME RATIO AND OPTICAL AND PHYSICAL PARAMETERS OF NEW STAR CLASS 2K PAINT

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In this paper, New Star Class Two-Component paint (New SC 2K) was used as an alternative automotive polyurethane paint. As a part of the recent project, Asian Paints Causeway (Pvt) Ltd. developed a New SC 2K paint with alternative ground liquid pigment which will give the ability to omit the pigment grinding stage of the manufacturing process. This pigment contains an unknown resin that might have hydroxyl functional groups that might change the needed isocyanate amount. Although the current paint: hardener volume ratio is 2:1, it is quite doubtful for the new paint. A series of different titrations were conducted to determine the paint: hardener volume ratio for new SC 2K paint. To measure acid value first, a known mass of the New SC 2K paint was dissolved in a neutral solvent mixture of toluene and ethanol and titrated against standard potassium hydroxide solution using phenolphthalein as an indicator. The obtained average acid value of paint was 3.47 mg KOH/g (new) and 4.26 mg KOH/g (current). The hydroxyl number of the paint was determined by the reaction of terminal hydroxyl groups with acetic anhydride. The acidic carboxyl groups (acetic acid) resulting from this reaction were neutralized with the equimolecular quantity of KOH. The result was 79.44 mg KOH/g (new) and 87.76 mg KOH/g (current). The isocyanate in the polyisocyanate source reacted with di-n-methylamine to form urea. Unreacted (excess) amine was determined by back-titration with hydrochloric acid. The isocyanate content was 21.5% by weight percent. Final resultant paint: hardener volume ratio was 2.3: 1 as calculated by combining titration analysis results. Physical parameters of New paint were performed by using Hegman fineness gauge, Elcometer Ford 4 viscosity cup, and Elcometer density cup. Optical parameters and quality assessments of these paint samples were performed after applying them on metal plates by using a color guide gloss spectrophotometer, pencil hardness tester, crosshatch adhesion, conical mandrel bend tester, and variable impact tester. Preliminary results indicated the New SC 2K paint sample was in good condition according to the required quality parameters. This work showed the great adhesion, and optical and physical qualities of new paint after mixing two parts of paint with one part of hardener (volume). It proved the ability to use the current 2:1 ratio.

Keywords: *automotive 2K paint, polyurethane, isocyanates, acid value, hydroxyl number*

ELECTRICAL AND MECHANICAL PROPERTIES OF RGO – RUBBER NANOCOMPOSITE

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Reduced graphene oxide (rGO) – rubber nanocomposites were prepared by maintaining the constant total weight of composite with different rGO to natural rubber ratios in each using Sri Lankan natural graphite and rubber as raw materials. Preparade composites were characterized by using Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron microscopy (SEM). The presence of the rGO and the rubber in the nanocomposites were verified by FTIR and XRD analysis without any structural changes. The SEM image of composites showed a uniform homogeneous surface of the composites. The tensile properties, hardness, and electrical properties of the composites were evaluated. The hardness and the young's modulus of the composites were improved with the addition of reduced graphene oxide dispersion. The highest tensile strength was observed at 1.5% of rGO in natural rubber. Also, the highest elongation at break, young's modulus, and the lowest strain was observed with 1.5% rGO in rubber. 1.5% of rGO in rubber was found as the optimum value for tensile strength, elongation at break, young's modulus, and strain. The hardness of the composites continuously increases with increasing reduced graphene oxide in the composite. Tensile tests of the nanocomposite were carried out according to D 412 / ISO 37 standard, and hardness was measured according to ISO 48 – 4: 2018 standard. The electrical conductivity started to exhibit with 1% of rGO and continuously increased with the addition of the rGO to the rubber matrix. The improved properties of reduced graphene oxide – rubber composite that investigated in the present study is convenient for many applications, including automobiles, electronic devices, electrical devices, batteries & capacitors, aerospace, consumer products, heavy equipment industry, etc. This study is a value addition to the local graphite and rubber industries.

Keywords: *Reduced graphene oxide; Graphene; natural rubber; rGO dispersion.*

HIGH HARDNESS TREAD COMPOUND DEVELOPMENT FOR THE SOLID TYRE USING VARIATIONS IN SILICA FILLER CONTENT

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The performance of the tyre, including ride and handling, rolling resistance, fuel consumption, tyre durability, noise, and vibration, is influenced by the tread material. The ability of a substance to withstand abrasion, indentation, cutting, and scratching is known as hardness. In the tyre industry, hardness is determined by using a durometer (shore A hardness tester). When increasing the hardness, the tyre tread gets stiffer. Therefore, the tyre will not deform easily which is good for rough applications. This study aimed to develop a new solid tyre tread compound with a Shore A hardness between 80-85 and to study other physical properties such as tensile strength, specific gravity, rebound resilience and abrasion test. The hardness was enhanced by altering the filler component. In order to improve the hardness carbon black and silica can be used. The use of Carbon black has drawbacks of high rolling resistance and processing difficulties. Therefore, Silica is used as the hardness-improving filler. The incorporation of silica has given outstanding properties like low rolling resistance, high abrasion resistance, high wet grip, and high load-carrying capability. Different tyre tread formulae were prepared by varying the silica ratio from 40 parts per hundred rubbers (phr) to 80 phr. Optimum properties were able to obtain at 70 phr. In the optimum formulae, shore A hardness was 82, rebound resilience value of 80phr sample was 43 %, tensile modules at 300 % elongation of tread compound were 166.94 kg cm^{-2}, and the tensile strength of tread compound was 226.83 kg cm^{-2}, and elongation at break of tread compound was 423 %. A successful tyre tread compound was developed using a natural and synthetic polymer blend (Butadiene/Styrene butadiene) with a 70 phr silica filler component. A tyre was manufactured using the optimum formula and a quality endurance drum test (QED) was done for the tyre which gave a 350 min run time.

Keywords*: Solid tyre, Silica, silane, Durometer, Hardness*

INVESTIGATION OF CAUSES OF INDUCING PINHOLES IN XLPE EXTRUSION IN WIRE AND CABLE INDUSTRY

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Inducing pinholes in cross-linked polyethylene (XLPE) extrusion is a critical factor in the cable industry. The possible causes for inducing pinholes identified as volatile matter content in XLPE extrusion and the size incompatibility of the masterbatch (MB) pellets and XLPE base material pellets. This report reveals the correlation between the volatile matter content of the masterbatch and the inducing pinholes on insulation. Due to the pinholes surface irregularities arise on XLPE insultion. The volatile matter content of the MB can be released by pre-heating the MB before feeding it to the extruder. But at elevated temperatures, MB pellets get aggregate which is not good for mixing. So, the best temperature is determined where maximum volatile matter is released and pellets do not aggregate. Laboratory experiments were conducted to determine the best temperature to preheat and the pre-heating time before conducting industrial trials. Graphs were obtained for each suitable temperature and pre-heating time was determined. Industrial trials were conducted according to the results obtained from laboratory trials. The results show the induing pinholes on the insulation of the cable of the industrial trials conducted at a suitable temperature. Size incompatibility of the MB pellets and XLPE pellets also identified as a possible cause for inducing pinholes. This part was done as a case study. Pellets were compared according to their volumes and melting rate was studied. Results show the relation between pellet size and the melting rate to inducing pinholes.

Keywords: *Masterbatch (MB), volatile matter, crosslinked polyethylene (XLPE), pinhole, High Voltage test (HV test)*

INVESTIGATING THE EFFECT OF SURFACTANT ON THE LATEX FILM FORMATION PROCESS OF SYNTHETIC POLYISOPRENE BY TRANSMISSION ELECTRON MICROSCOPY

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Latex film formation is an essential process to produce the latex-based products. A continuous, homogeneous film can be formed on a substrate by evaporating water from a latex dispersion under the appropriate conditions. This formed film is known as a latex film and the process is known as the "latex film formation process". It is established that the latex film formation process is affected by the minimum film forming temperature, type and concentration of the surfactant, identity and particle size of the latex, and water content in the latex film. This process involves multiple stages, starting from a dilute dispersion which eventually converts into the final continuous polymer film through a concentrated dispersion and a packed array of particles. From a modeling perspective, it is conventional to split the process into three sequential steps: drying, particle deformation, and diffusion. This study evaluates the effect of sodium dodecyl benzene sulfonate (SDBS) surfactant on the drying rate of the latex film formation process. Samples T2, T3, and T4 were prepared by diluting the raw synthetic polyisoprene (T1) using distilled water by 50%, 75%, and 90% dilution factors, respectively. The sample T5 was prepared by adding SDBS surfactant to sample T4. Subsequently, the samples were analyzed by TEM. No obvious surface patterns were observed in the latex films which were formed without the surfactant (T1-T4). Even though some areas of sample T5 did not show any surface patterns, disrupted honeycomb structure was observed in some areas of the latex film. Hence, we suggest that latex particles formed with the aid of the surfactant undergo partial deformation while the latex films formed without sodium dodecyl benzene sulfonate (SDBS) surfactant have completed the deformation stage. Since a similar drying time was used in both cases, we conclude that the SDBS surfactant slows down the film formation process of synthetic polyisoprene.

Keywords: *Latex film formation, Transmission electron microscopy, Synthetic polyisoprene, Sodium dodecyl benzene sulfonate*

OPTIMIZING GLOVE GRIP OF DISPOSABLE SURGICAL GLOVES FROM NATURAL RUBBER LATEX

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Optimum surface friction or grip is an essential property to maintain in disposable surgical gloves used in the healthcare sector. It is important for handling sensitive instruments used in surgeries. These gloves should be able to don (wear) easily, comfortably, and safely during surgeries. Both powdered gloves and powder-free gloves are used as surgical gloves. The powder-free glove was introduced to protect healthcare workers who have an allergy to powders used in powdered gloves. Powdered gloves can maintain their surface friction using these powders. But powder-free gloves need post-treatments after the dipping process to maintain optimum grip. Therefore, through the research, modifications that can be made to the post-process to obtain an optimum grip were identified. Among the post-processes, the main focus was given for chlorination and siliconization steps. The chlorine concentration was changed in three samples during the chlorination process, and the grip was measured. Scanning electron microscopy (SEM) images were used to observe the surface morphology of the gloves. In the siliconization process, polydimethylsiloxane (PDMS) quantities were varied, and obtained the SEM with elemental analysis. Fourier transform infrared (FTIR) spectra were obtained with and without PDMS. In addition, the variation of the grip of the gloves were measured with the number of siliconization cycles. The total solid content (TSC) in the batch was calculated to identify a relationship between TSC and the grip. Moreover, the relationship between the maturation time of compounded natural rubber latex and the grip as investigated. The variation of the grip was measured using two methods; manual grip rating and instrumental measurement. Manual grip rating results were analyzed using the Kruskal-Wallis statistical analysis method and the instrumental grip measurements were analysed using a friction coefficient method. According to the results, the high chlorine concentration in the chlorination process showed the optimum grip of the glove with respect to the other two chlorine concentrations. In addition, it was identified that PDMS is an important silicone that should be present in the siliconization process, and it showed better glove grip with increased quantities of PDMS. Besides, it was observed that the TSC of a siliconizing solution affects the glove grip of surgical gloves. Finally, suggestions were made to investigate the best TSC that does not affect the silicone quantities to obtain an optimum grip.

Keywords: *Glove grip, Disposable surgical gloves, Chlorination, Siliconization, SEM*

OPTIMIZATION OF DITHIOCARBAMATE/XANTHATE BINARY ACCELERATOR SYSTEM FOR THE TENSILE STRENGTH IMPROVEMENT OF SYNTHETIC POLYISOPRENE SURGICAL GLOVES

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For surgical finesse, the final product expects exceptional dexterity and tactile sensitivity achieved by the inherited tensile properties of the film product. Generally, Natural Rubber(NR) shows superior tensile properties with respect to synthetic rubber(SR). Tensile strength is mainly attributed by the strain-induced crystallization phenomenon which occurs due to the higher non-rubber content of the latex. The non-rubber content present in the latex retard long chain branching and promotes more crystalizable sites for SIC (Strain Induced Crystallization). In Ansell, an ACD (allergic contact dermatitis) safe binary accelerator system is implemented for surgical grade syn-polyisoprene gloves production, where Accelerator 1 belongs to dithiocarbamate class (Figure1) while accelerator 2 belongs to the xanthate class (Figure 2). The resultant vulcazite products showed alarming tensile result variation over mass production. The objective of this research work is to extensively study the novel binary accelerator system to optimize the primary: secondary accelerator ratio in order to boost the tensile results. In the present study, the ratio of the separate binary accelerators was manipulated in a series of 5 trials of keeping the total accelerator load constant. Crosslinking density of the matrix is extensively studied with respect to the cure characteristics, tensile strength, elongation at break and modulus of the final vulcazites. Crosslinking density of the matrix is extensively studied with respect to the cure characteristics, tensile strength, elongation at break and modulus of the final vulcazites. Primary accelerator: secondary accelerator determines the chain length distribution of the crosslinks. When the primary accelerator dominates the crosslinking density increases which results for shorter chain length distributions that act as nucleation sites for crystalline sites. When there are more nucleation sites SIC increases. When there are more SIC those induced sites slow down, deviate and even stop the crack growth and cause for tensile strength. But when there are more crystalline sites the matrix restricts free chain movement causing low elongation at break. When the primary: secondary accelerator ratio is high the final vulcazite showed the highest tensile strength and least elongation at break. The respective vulcazites in general showed the most prominent mechanical properties with the least difference between the aged and unaged. But the TSI (Toluene Swelling Index) dropping rate for the respective trial was the least. In order to minimize the disadvantage caused, the phase transitions of glove mix preparation were suggested to be completed at a higher TSI value from the existing SOP (Standard Of Procedure).

Keywords: *Vulcanization, binary accelerators, dithiocarbamate, xanthate, tensile properties*

POLYALININE (PANI)/ REDUCED GRAPHENE OXIDE (RGO) COMPOSITE FOR NH_3 SENSING APPLICATIONS

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The toxic and flammable nature of gases imposes a harsh obstacle for the industries that utilize them. Therefore, gas sensors are normally used for monitoring the content of gases in the air to ensure environmental protection and labour protection. Conductive polymer based rGO composites are the best approach for introduced NH_3 sensing applications effectively due to the high intrinsic electrical conductivity. So polyaniline has attractiveproperties such as feasibility, stability and easy synthesis. Here, the goal of this research is to find best electric conductive ratio of PANI and rGO that can be made from spin coating, electrospinning and screen printing methods. Electrical resistance of the composites can be check by using Keithley® 4200-SCS equipment before fabricate it. First Polyaniline-emeraldine salt (PANI-ES) powder was dissolved in N-methyl-2-pyrrolidone (NMP) solvent. Then rGO was added according to PANI-ES: RGO ratio of 5:0.5, 5:1, 5:1.5 (A, B, C). After utilizing a conductive substrate by electrospinning and screen printing the electrodes were connected to measure composite's NH_3 sensing using a NH_3 sensing chamber. Lowest detection limit of NH3 was measured as 10 ppm and at 100 ppm detection limit the composites showed about 230% of percent variation of resistance. Electrospinned and spin coating samples showed some inconvenience due to some disability. However, average time to respond was above 200 s. Among the ratios, PANI-ES: RGO 5:1.5 ratio was observed as for best results. According to the study, PANI deprotonation process with NH_3 and also rGO higher surface area was facilitated to the sensitivity of the device. Here, PANI deprotonation was immensely contributed for the reduction in conductivity and carboxylic groups of rGO was contributed for facilitate interactions. Electrospinning procedure disabled due to the lower molecular weight of the composite solution and it can be enhanced by adding Polyvinyl alcohol polymer for further study. Though electrospinning was not succeeded due to the higher surface area generation from nano fibers may contribute for higher sensitive applications. However, miniaturized gas sensors are suitable for industrial applications. Therefore, polymer composite based device can be manipulated in small spaces and can gain high results from that through suitable display or alarming system.

Keywords*: Sensor, Polyaniline composite, Reduced graphene oxide, Electrospinning, Screen prin*

PREPARATION & CHARACTERIZATION OF POLYBUTYLENE ADIPATE TEREPHTHALATE (PBAT)/CASSAVA BIODEGRADABLE COMPOSITE FILM

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Biodegradable composite films of Polybutylene adipate terephthalate (PBAT) were prepared by maintaining a constant total weight of composite with different Cassava starch to PBAT ratios. Cassava starch was used as the filler to reduce the cost of the composite material. Series of PBAT/Cassava composite were prepared for five levels of filler loading (10, 20, 30, 40, and 50 wt%) and the composite films were extruded by a laboratory scale Brabender extruder at the optimum sorbitol loading of 4 wt% as a plasticizer. The changes in functional groups and physical properties of the composite films were analyzed by Fourier transforms infrared (FTIR) spectroscopy, and universal tensile testing machine respectively. Aqueous food test (SLS 1718: 2021 – 70 ℃) and fatty food test-substitute test (BSEN – 1186 – 1, BSEN – 1186 - 14) were carried out to analyze the total migration of residues of composite films. The observed moisture content of the original "Cassava powder" was 5.82%. Neither the peak position nor the intensity of the film's distinctive infrared absorption peaks was altered by the addition of Cassava starch to PBAT. Therefore, adding Cassava starch to PBAT is solely a physical process. Experimental results show that the increase of cassava starch content, the tensile strength, elongation at break, and the tear resistance of the composite film are decreased. The mechanical properties of the composite film can be significantly improved by reducing the amount of filler loading. The "40% Cassava starch" included composite film was selected as the optimized composition since it is cost-effective while acquiring the required physical properties to be a better fit as a packaging material. But the overall migration of residue of the surface of the "40% PBAT/Cassava starch" sample wasn't in the acceptable range (<10 mg/dm^2). Therefore, the extrusion process of the composite needs to be further modified.

Keywords: *Biodegradable composite, PBAT, Cassava starch, Extrusion, Mechanical Properties.*

RECYCLING OF WASTE SPANDEX/NYLON BLENDED FABRIC THROUGH MELT MIXING AS A SUSTAINABLE APPROACH

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As a solution for the recycling of the nylon/spandex waste fabrics, blended fabrics were produced by melt mixing and compression moulding. This research mainly focused on thermal recycling. Here primarily investigated the influence of processing parameters on melt mixing and the properties of the blended fabrics. The high composition of spandex/nylon fabric and the low composition of the spandex/nylon fabric were used for all testing and processing. A laboratory-scale plastic mill was used as an internal mixer for mixing. A laboratory scale hydraulic pressure compression moulder was used for making sheets. There was sticky nature in sheets after compression moulding. Morphological analysis shows that there is no phase separation to identify clearly. Thermal analysis determines there is not much influence in nylon/spandex composition on the melting and thermal degradation of the nylon6/spandex fabrics. As well as it shows there is more tendency to degrade Spandex. Thermal degradation was investigated using thermal gravimetric analysis. Melting and glass transition temperatures were investigated using a differential scanning calorimetric study. The gas identification shows that gases were produced during the melting process. Gas chromatography-mass chromatography was used as the analytical technique when making gas identification. Studies showed that fabric waste happens largely, and recycling should also be done. Hence it is not easy to use different parameters for different compositions. This study proves it can use the same parameters for melt mixing to all ratios of Nylon and Spandex. It was confirmed by using higher and lower compositions of spandex fabrics for testing.

Keywords*: recycling, fabrics, compression moulding, mechanical properties.*

REDUCTION OF HEAT PRESS MARK IN SEW-FREE FABRIC BONDING

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In this experiment, the reduction of the press mark effect occurring on the fabric in the process of bonding was evaluated followed by testing to find a method for the reduction of the press mark effect on the final application. The trials were initiated with a satin fabric and a preselected film adhesive with high glue line temperature and was bonded together under two pressure levels to observe the effect of the pressure on the press mark occurrence followed by the evaluation of the press mark effect corresponding to different bed materials and cover sheets. At the end of the testing, it was concluded that the occurrence of the press mark is due to the material losing its surface structure by flattening due to the nearing of the melting temperature of the fabric by the pressure and heat exerted on the fabric. The results showed that by using a bed material with a 3D surface texture and high GSM cotton fabric with prominent fabric lines can reduce the press mark effect drastically. At the end of the experiment future directions and developments were discussed in order to further reduce the press mark effect also known as shine marks on the fabric.

Keywords: *Saw-Free, Fabric, Polymer, Heat-Press, Bonding*

SEPARATE NYLON AND SPANDEX COMPONENTS FROM WASTE NYLON /SPANDEX BLENDED YARNS USING SOLVENT EXTRACTION PROCESS

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As the use of spandex-containing fabrics for garment applications grows, creating environmentally acceptable ways to recycle industrial and post-consumer waste for spandex-blended fabrics becomes more essential. If improperly disposed of, the nylon (PA)/polyurethane (PU) scraps generated during the sanding process would result in significant resource waste and environmental concern. As a result, this research provided a practical way for extracting the nylon and spandex components from Nylon /Spandex blended yarn. Spandex can be removed from blended yarns by dissolving it in solvent DMF, as proven in this study. However, the use of such chemicals is undesirable for economic and environmental reasons. The results revealed that at 160^0C, spandex dissolves in DMF in a closed system DMF could be utilized in a closed system in the industry to separate nylon and spandex if the DMF does not dispose to the environment. The major objective of this research was to separate nylon and spandex from blended yarns and come up with an alternative chemical for solvent extraction to remove the spandex component from nylon/spandex blended yarns so that they could be recycled. To test the dissolution of spandex, run the test trials using alternatives such as n-Butyl acetate/Cyclohexanone blend, Acetonitrile, and Cyrene. Spandex didn't show any difference with Acetonitrile but in initial trials n-Butyl acetate/Cyclohexanone showed the same results as DMF. Spandex didn't give the expected results when it was heated to the boiling point of cyrene to test the dissolution of spandex.

Keywords: *Spandex/Nylon Blend, DMF, Cyrene, n-Butyl acetate/Cyclohexanone, Acetonitrile, Soxh*

SOYA FLOUR AS SUSTAINABLE FILLER TO REPLACE CARBON BLACK IN TIRE TREAD COMPOUND

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Tire manufacturing represents a significant fraction of the field of dry rubber. The main ingredients used to manufacture tire compounds are elastomers (mainly dry rubber), fillers, vulcanization systems, activators, accelerators, antioxidants, and processing oil. Almost all components in tire formulation are synthetic materials except natural rubber. Due to the present shortage of resources (mainly fossil fuels), there is a tendency towards sustainable alternatives. Biomaterials, as one of the sustainable alternatives, have been used to find the possibility of use in rubber compounds. Soya protein is one of the biomaterials utilized successfully in rubber compounds. This study aims to identify a possible ratio of soya flour (SF) and the applicability of different compatibilization agents between SF and natural rubber (NR) by replacing a certain amount of carbon black (CB) in the tire tread compound. So, this study initially focuses on replacing 10 phr of CB with SF since previous study results have shown acceptable properties with adding 10 phr of SF. Adding 10 phr of pure SF by removing CB shows a slight reduction of tensile strength while a considerable improvement of abrasion loss and comparable values for other properties. Then the same amount of SF was used with silane compatibilizing agent (10:1 ratio; generally, in the industrial scale, silane is used in 1/10 with silica filler. Thus, the same ratio was used with the SF by following the same procedure), which shows similar properties to the control. Then 15 phr of SF was used with silane since 10 phr of SF with silane showed acceptable properties. However, they show lower properties than adding 10 phr of SF with silane. Then 10 phr of SF was tested with another compatibilizing agent: calcium sulfate dehydrate (CSD). It acts as a physical crosslinker between polar functional groups on SF and protein moieties of NR. Two formulations were prepared and tested with CSD, one with CSD and the other with silane and CSD. These two formulations show higher abrasion loss than the use of 10 phr of SF with silane. All trials show acceptable behaviour in aging tests, and any of them doesn't show negative observation with indoor or outdoor blooming tests. Thus, replacing 10 phr of CB with SF using silane as a compatibilizing agent is acceptable for production.

Keywords: *Tire compounding, Soya flour, Carbon black, Silane, Calcium sulfate dehydrate*

USE OF SUGARCANE BAGASSE ASH AS A FILLER TO REPLACE REGULAR SILICA IN TYRE COMPOUNDING

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Sugarcane bagasse (SCB) is the fibrous waste material remains after the extraction of sugarcane juice from sugarcane stalks in sugar production. The main components of sugarcane bagasse are cellulose, hemicellulose, lignin and other inorganic materials. In sugar production plants, this fiber waste product is used as an energy source. Sugarcane bagasse ash (SCBA) is the residual ash that remains after the combustion process of sugarcane bagasse. The major components remaining in the ash after combustion are silica, alumina, ferrous oxide and calcium oxide. Therefore, SCBA is a potential alternative silica resource. In this project the partial replacement of commercial silica by SCBA in tyre tread formulation was studied. In this study, purification procedure of SCBA was carried out by acid treatment and alkaline treatment of SCBA. But a lower amount of silica yield was obtained through this process. In two laboratory trials, partial replacement of commercial silica by SCBA was done. In the first trail ≤ 180 μm particle size of bagasse ash was used and the SCBA filler loading which gives optimum properties was investigated. To characterize the rubber compound, curing properties, tensile strength, tearing strength, abrasion loss, hardness, rebound resilience, adhesion strength, heat buildup and Sulphur blooming tests were performed. According to the obtained results from the first trial, 5 parts per hundred rubber (pphr) is the optimum amount of pphr level at which SCBA can be used as a filler. The reason for less partial replacement of silica may be due to the low amount of silica content present in the used ash sample, the high amount of unburnt carbon present in the sample, the higher particle size of SCBA and consequently, the smaller specific surface area of ash. Then a second laboratory trial was conducted by reducing the particle size of SCBA up to ≤75 μm and using both heated and non-heated SCBA samples. Therefore, through the second trial, two variables, which are effect of particle size of sugarcane bagasse ash and effect of heating sugarcane bagasse ash were investigated. According to the second trial results, the properties of the heated bagasse ash sample (5 pphr filler loading) exhibited higher properties compared to all the other test samples. And its properties are comparable with those of the regular sample. Therefore, the reason for the increment of properties is either the reduction of the particle size of the sugarcane bagasse ash or heating of the bagasse ash. Further investigation of the effect of the use of a different grade of sugarcane bagasse ash and partial replacement of regular silica in a base formulation or cushion formulation in tyre compounding can improve this research further.

***Keywords**: Sustainability, Tyre manufacturing, Rubber compounding, Filler, Sugarcane Bagasse Ash*

Robotics and Software Development

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A METHOD TO CALCULATE THE COST OF A TRAIN IN SRI LANKA RAILWAYS

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One of the main forms of transportation in Sri Lanka is rail. Rail transport service was established in 1864 by the British community with the intention of offering transportation services for both freight and passengers. Ceylon Government Railway (CGR) was originally known as Sri Lanka Railways. To create economic and social benefits, rail networks must be effective. It should have an appropriate cost regulation because it is Sri Lanka's main form of transportation. Due to the current flaws, they are inspired to make a sophisticated costing strategy. The very basic costing methodology the railway department now employs is their main challenge. In order to effectively determine the entire cost of a train, they will use this novel method. The major goal of this study is to examine and study a technique for figuring out a cost of a train under the present Sri Lankan railways schedule. The railway department will find it useful to assess the overall cost. Cost variables are main inputs of the research and using this application it can be identified the total cost of a train per km. The sub departments of Railways in Sri Lanka provided the annual data for 2019 that were used in this analysis. Additionally, the commercial sub department of Sri Lanka Railway (SLR) gathered the Excel version of the data that was provided. The behavior of the data was investigated, and user requirements were gathered. The computer program was created using Java to satisfy user needs. With data, the computer software will be tested. The end product will be the implementation of the computer software. Based on the application, SLRs can increase revenue while also benefiting passengers by increasing the number of wagons while maintaining the same level of train expenditures. Future forecasting is also a critical situation related to transportation. As an example, according to the country’s situation, fuel prices, dollar rate and salaries can be changed. In such a case, SLR may provide valid evidence to the relevant authority in making the decision to adjust the system to suit the changes.

Keywords: *Cost calculation, Cost of a train, Rail transportation, Java*

PEDESTRIAN WALKING BEHAVIORAL ANALYSIS METHOD USING 3D MULTI-PERSON POSE ESTIMATION FOR AN AUTONOMOUS VEHICLE

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Autonomous vehicles have become the latest innovation in technology in later years. Autonomous vehicles have become a significant turning point with many perks in the automotive industry. Tesla, Pony.ai, and Waymo are the most innovative autonomous vehicle manufacturing companies. Pedestrian safety is number one, whether a human-controlled or autonomous vehicle. Pedestrian intention prediction plays a vital role in leading to more accurate interventions. Autonomous vehicles can be trained with sensitive sensors to enhance pedestrian safety by eliminating human Errors in human-controlled vehicles. This study mainly focused on creating a camera-based method for an autonomous vehicle to analyze multi-pedestrian walking behavior using 3D pose estimation to enhance the safety of pedestrians. However, previously proposed pedestrian intention methods are highly accurate and speedy and were done using a 3D skeleton with some limitations because they are limited to a single 3D skeleton. Moreover, they only identified whether the person started or stopped walking without producing enough details about the Pedestrian's walking direction. Therefore, a method that can identify Pedestrian walking direction is an aspect of a pedestrian safety system. This method analyzes the walking behavior of multi-pedestrian using the 3D pose estimation method by filling this research gap. This research aims to develop an algorithm that can be used to get the Pedestrian walking direction, and an inductive technique was adopted. An existing 3D pose estimation method was used and developed to suit an autonomous vehicle. A line should be created to predict a pedestrian's walking direction and two coordinates should have been known. Here, mainly x and z coordinates of the right hip, left hip, right foot index, and left foot index are used to predict pedestrians' walking direction. This method can be predicted whether the pedestrians are coming toward the vehicle or going away from the vehicle within 50ms with the help of simple geometry and also the average error for each measurement will lie below 15%. Researchers in this field always try to reduce the predicting time because it is the most important factor in this field.

Keywords: *Autonomous vehicles, 3D pose, Pedestrians*

RAW MATERIAL RISK ANALYSIS IN APPAREL INDUSTRY OF SRI LANKA USING MACHINE LEARNING

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Sri Lanka is one of the significant top notch pieces of clothing providers in the world. Raw material plays a big role in the production of high quality garment in a factory. Natural substance risk early admonition is one of the significant realities to forestall businesses from falling into creation process trouble. As a matter of fact, the clothing business faces various issues when it goes through the entire interaction. The issues are sorted into different classes in light of the activity cycles of the attire business, including clothing plan, assembling, retailing, and production network the board. Here it shows the Raw Material Risk based on demand of the production based on supply chain management. This paper presents an art of artificial intelligence (AI) applications in the apparel industry. The exhibition of the propose techniques or models are tried in view of information that were taken from MAS Bodyline (Pvt) Ltd. The reasonable machine learning (ML) models and ideas for additional examinations are advertised. This strategy, first recognize the features and labels that are exceptionally add to the models. This paper proposes investigation techniques in light of AI. Which are further used for supervising learning to indicate that uses an algorithm to understand the relationship between dependent and independent variable and also help to predicting numerical values based on different data points. This technique distinguishes the features and labels that are highly contribute to the models using knowing details and using correlation coefficient values. This paper proposes examination strategies in view of ML models. Extreme objective of this learning are anticipated results for new information by means of ML models. Detailed information about Logistic regression and Support vector method are calculated through python programing in anaconda navigator environment with Jupiter note book. Other than ultimate goal, this research aims to predict the factors that affect for raw material risk using ML. In this exploration, constructing an ideal model is focused on which can be utilized to anticipate the stock equilibrium pertinent to the elements liable for the impact of the unrefined substance risk, with the goal that the discoveries can assist the association with answering early cautioning to natural substance risk. The vast majority of the pieces of clothing producers actually follow the obsolete stock administration strategy utilizing Succeed records. In this study bring new defining moment for stock examination with natural substance risk investigation utilizing AI.

Keywords: *Apparel Industry, Artificial Intelligence, Machine Learning, Raw Materials, Risk Analysis*

VOICE TO POSE CONVERTER PROGRAM FOR HUMANOID ROBOTICS

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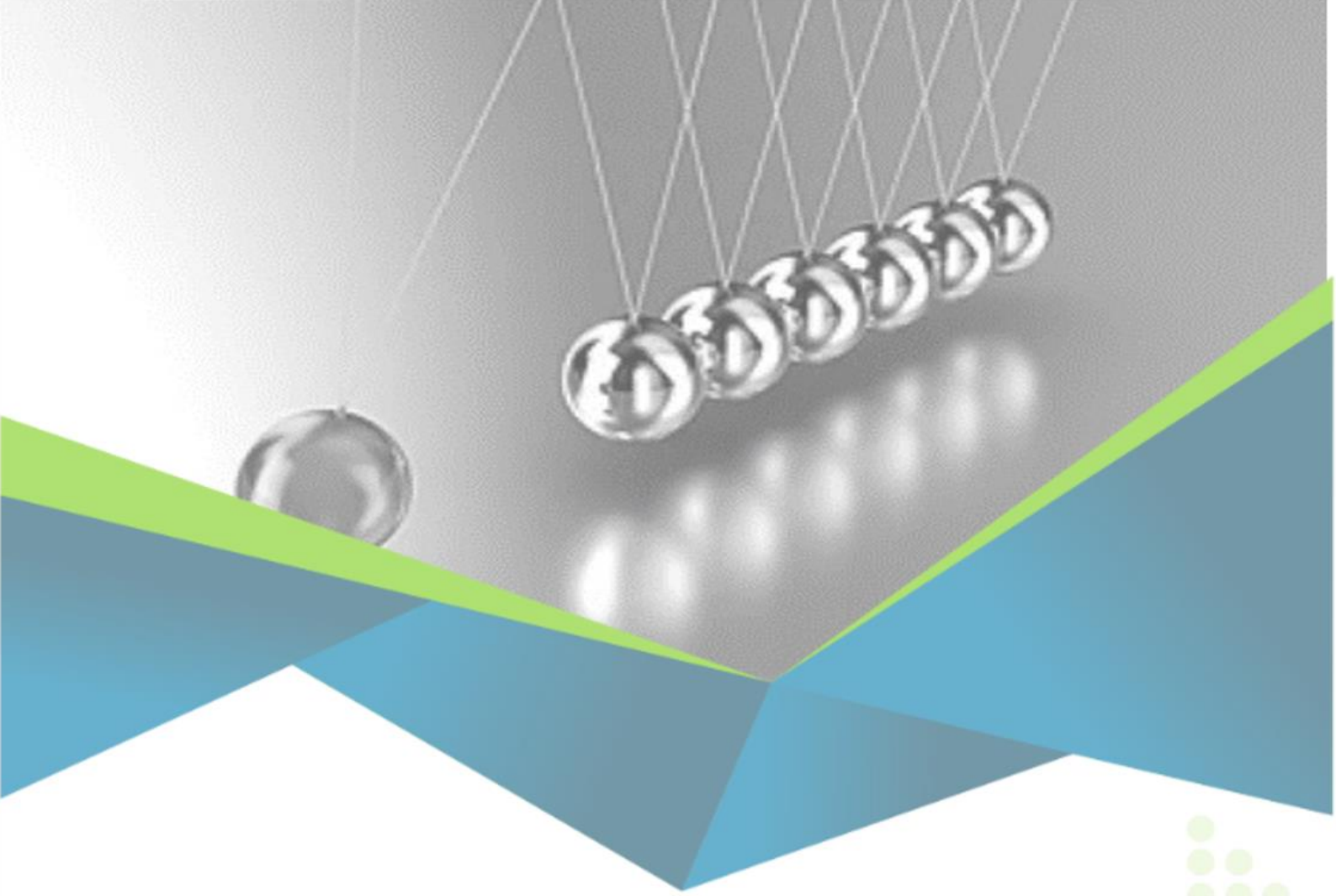
Humanoid robotics is emerging at an exponential rate in the 21st century with the advancement of NLP and AI-based applications to adapt to the human environment by interacting flawlessly with humans. NLP is an excellent candidate to supply a good interface for humanoid robotics. Nevertheless, NLP focuses only on verbal communication, which does not involve nonverbal communication. Since nonverbal communication holds a more significant portion of "Communication", there is a requirement to build a system for generating body language like hand gestures and body movements prediction. This research used video clips and famous English movie clips to train a machine learning model to generate a full-body pose corresponding to the speech. As inputs, a continuous array of image snapshots has been extracted from the video clip, and the words extracted from the audio track of the corresponding video clip. Using a neural network with deep and LSTM layers, I have built a model that accepts English sentences as input and outputs the body pose array with corresponding illustrations. To train that model, over 50000 data samples were utilized from various video sources on the internet like YouTube and FaceBook. The data were extracted using simple python programs, and also I have used Google speech recognition APIs to generate texts for the audio tracks. After training and tuning the final model, the model achieved 72.3% of training accuracy with functional performance. Even though results are illustrated on point images with skeleton structure, the result values can be directly utilized on ROS node to publish as joint kinematics of the actual robot.

Keywords*: Humanoid Robotics, NLP, Non-Verbal, Communication, LSTM*



Theoretical and Applied Physics

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A STUDY OF MECHANICAL PROPERTIES AND MICROSTRUCTURE OF GRAPHENE OXIDE MODIFIED CEMENT-BASED COMPOSITES

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Cement-based materials are the most widely used construction material in the civil engineering industry. Therefore, improving its quality is important. This research focuses on the improvement of the compressive strength of cementitious materials using Graphene Oxide (GO). When the strength of the cement is improved using GO, a lower quantity of cement is required for building purposes. It is a cost-effective method of enhancing strength and the environmental damage occurrence is minimum in the cement manufacturing processes. When GO was mixed with concrete, the compressive strength of the concrete was observed low compared to normal concrete. The reason for that was observed as an agglomeration of GO. pH (13 pH) and the [Ca^{2+}] were identified as the causes of agglomeration, with the help of UV-visible spectroscopic analysis. To prevent the agglomeration of GO, Poly Carboxylate Ether (PCE) should be added. When PCE was added, GO sheets will be masked from PCE and it lowers the ability of Ca^{2+} to reach towards GO sheets, due to high steric hindrance. As well as it delays the reduction of GO. Thereafter the solubility problem was solved, hence the compressive strength was increased. To figure out an optimum GO content, a series of tests with different GO percentages (0.01%, 0.02%, 0.03%, 0.04%, 0.05%) were done. There, the optimum GO content was observed as 0.03%. In that sample, the compressive strength improvement of concrete after 7 days was observed at 12.18% and 28 days was observed as 15.20% with respect to normal concrete. Further optimizations are expected to be done to enhance this percentage. When the GO amount was increased, the workability was observed to be lower. When the microstructure of GO was modified, cement was observed using Scanning Electron Microscope (SEM) images, and a flower-like crystal formation was observed in 0.03% of GO containing the cement sample. The reason for enhancing the strength of cement was the formation of a nanoscale even crystal structure (flower-like structure) with the enhancement of the hydration process on the nanoscale. Crystal formation was done on the GO sheets, which is called as template effect.

***Keywords**: Graphene Oxide, Compressive Strength, Flower-like Crystals, Cement*

DEVELOPMENTMENT OF OPEN ACCESS ENVIRONMENT BASED ON IOT TO STUDY ELECTRIC POTENTIAL CHANGE OF MIMOSA PUDICA PLANT WITH HUMAN INTERACTIONS

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Although plants don't have nerves, their cells can, however, generate electric potential signals. Even though the magnitudes of electrical reactions can occasionally range from 10 mV to 100 mV when triggered by the environment at frequencies between 1 and 10 Hz, electrical components can be discovered in all biological cells. Action potentials (AP), which are referred to as fast signals, and variation potentials, which are slower electrical signals, have both been identified in plants (VP). Additionally, system potential (SP) has recently been proposed. Extracellular recording and intracellular recording are the two separate techniques used to measure plant electric potentials. Measurements of extracellular potential on the surface of higher plants have been widely used. They have the advantage of detecting electrical potential changes over a long period. The effectiveness of intracellular potential measurements, which use penetrating glass microelectrodes, is short-lived. The Internet of Things (IoT) is a network of interconnected computers, mechanical and digital devices, as well as objects, animals, and people. These devices all have unique identifiers (UIDs) and the ability to transfer data without the need for human-to-human or human-to-computer interaction. The main goal is to develop an open-access environment based on IoT to obtain data on how *Mimosa pudica* plant EPs change in response to human interactions. Finally, it can be said that this research showed that human activities, such as changing the lighting, watering, and controlling the humidity, varied the EP of the mimosa plant.

Keywords*: electric potential, action potential, mimosa pudica, Internet of Things*

INTERMEDIATE CHECKS FOR POWER METERS

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Nowadays, we measure practically everything we encounter. It includes everything from the pill taken at home to the x-ray taken at the hospital. Furthermore, measuring instruments contribute to our export and import industries. Therefore, they should be calibrated accurately. The equipment used to calibrate should be of confidence or good condition between two of its calibrations. Actions for that are intermediate checks which are periodic checks performed within the calibration period to confirm that the device is still in usable condition. This ensures the stability of a calibrated instrument for use throughout the calibration period and allows corrective actions to be taken if any deviation occurs after calibration. Also, it is a very important component in obtaining ISO/IEC 17025 certification, which is a global quality standard for calibrating and testing laboratories and is a quality baseline document for accreditation by an accreditation body. So, the focus of this study was to develop intermediate checks to PWS 2.3 meters for 3 different cases. Here the intermediate checks involve observing the variation of the meters over time, comparing them pairwise, and comparing meters with the reference standard for the selected points from the calibration points. Then voltage, current, and power at regular time intervals, and introduction of suitable controls charts and statistical tests to identify deviations, deviated items and appropriate corrective action needed to be done. The above intermediate check procedure was implemented only for a selected point. Then according to the control charts, it is seen that there are no outliers and according to case No3 there is some drift in the PWS 2.3 No2. And it can be concluded that the others are in usable conditions. With this intermediate check design, it is possible to verify whether the instruments are still within the acceptable range and whether any drift has occurred after the calibration. Then the right steps can be taken for them. Also, it improves the accuracy of measurements done by the equipment, supports achieving quality standards, and saves cost and time.

Keywords: *PWS 2.3 meter, Mann-Whitney, E_n value, Calibration period*

INVESTIGATION OF THE ELECTRIC SIGNAL GENERATION AND PROPAGATION OF THE MIMOSA PUDICA PLANT UNDER VARIATION OF ENVIRONMENTAL LIGHT CONDITIONS

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Generally, plant responses to environmental changes are mainly associated with electrical excitability and signalling. Further, continuous measurements of electrical potential differences (EP) between plant tissues can effectively study the information transport mechanisms and physiological responses resulting from external stimuli. In addition, abiotic and biotic environmental changes are frequently associated with generating and conducting electrochemical impulses within plant tissues and organs. In other words, even though plants do not possess the nerves and muscles as other sensible organisms, they can rapidly react to various stimuli such as touch, temperature, and more. During this study, one such plant species called *"Mimosa Pudica" ('Nidikumba'*) will be considered. Usually, it is rare to find research related to studying the living behaviours and electric signalling of plants in Sri Lanka. But in 2015, Insharp Technologies PVT Ltd launched the "Talking Trees" project with the ultimate goal of understanding and communicating with trees and plants. However, there is a research gap between the above research and the “Talking Trees” project; since the "Talking Trees" project, the primary purpose was to communicate with plants by understanding the signals emitted by *"Mimosa Pudica"* under different environmental conditions. This research will reduce the lack of research gap by identifying the electric potential (EP) variation pattern of the *Mimosa pudica* plant under different light intensity variations. Here, electrical potential (EP) differences are monitored using silver electrodes wrapped around a Mimosa branch in a pre-defined (one-hour) time period. Additionally, systematic patterns of EP and light intensity are discussed in different light conditions, including low light and white light (red+green+blue). This was used as an alternative tool to discover plants' behaviour and internal communication patterns. Overall, research investigations reveal that, during low light conditions, EP signals get low, and they are subsequently increased during high light conditions. Afterwards, when the light goes to low intensity, eventually EP signal also decreases. Furthermore, this EP variation positively correlates with the intensity of light falling on the plant. In addition, this research observed the effects of noise, the faraday cage, and noise filtration during the investigation. So, these explorations can further develop to investigate plants' reactions to identify the connection between stimuli and plants and can also utilize as a novel way to enhance the efficiency of local crop production under various environmental conditions.

Keywords: *plant electrical potential, plant signalling, mimosa pudica, plant sensors*

STANDARDIZATION PROTOCOL FOR CALIBRATION OF PRESSURE MEASURING EQUIPMENT (WITHOUT A PRESSURE INPUT PORT)

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Measuring the pressure parameter in various fields is often essential. Those different fields use different pressure instruments to measure the pressure. In the fields, instrument gauges (without a pressure input port) are among the leading instruments used to measure pressure. If the pressure is not measured correctly in some fields, serious issues could develop such as incorrect calculations could, environmental harm, human illness, massive explosions, etc. Therefore, it is essential to reliably and accurately measure the pressure in those fields. So, it is very important to make sure that the readings shown in that pressure measuring equipment (without a pressure input port) are the correct measurements. This is done by estimating the error and uncertainty via calibration of the instrument, which is calculated by comparing the measuring instruments against a reference standard. These types of calibration services are provided by the Measurements Units Standard and Services Department (MUSSD) for laboratories and industries in Sri Lanka. This laboratory has systems and protocols for calibrating pressure measuring equipment (with pressure input port). But there is no standard measuring system to calibrate pressure measuring equipment (without a pressure input port) for pressure parameter in Sri Lanka. Therefore, determining the uncertainty of the pressure measuring equipment and introducing a standard system and protocol to calibrate the pressure parameters of the pressure measuring equipment (without a pressure input port) were the main goals of this study (without a pressure input port). The proposed setup consists of a pressure controller, a pressure chamber, an RPM4 reference standard, and an N2 gas cylinder. These are connected by using pressure tubes. The various types of pressure measuring equipment (without a pressure input port) were used to do this test. In this, obtained the readings related to measurement points and calculated uncertainty to each measurement point. In this test, the uncertainty + error, uncertainty - error, and error graph lines should be lying between the accuracy of pressure measuring devices. Out of the 19 data loggers we used to calibrate, the uncertainty of 15 data loggers was within the corresponding accuracy range and the uncertainty of 4 data loggers was not within the corresponding accuracy range, because those 4 data loggers' sensors crashed over time. Hence the proposed protocol and calibration system was successfully and average accuracy of 90%. The proposed method will be helpful for Sri Lanka's industries, Calibration and testing laboratories, hospitals, and environmental authorities.

Keywords: *pressure parameter, calibration protocol*

STUDY OF PHYSICAL TESTING METHODS AND EVALUATION OF MEASUREMENT UNCERTAINTY OF STANDARD PHYSICAL TESTING METHODS OF TEXILE TESTING

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Textile testing and uncertainty of measurement are very important for the textile industry to check the quality and suitability of raw materials. The physical testing methods of textile testing were studied under the standard conditions. The standard temperature and relative humidity maintained at $20 \pm 2℃$ and $65\% \pm 5\%$ respectively. The measurement uncertainty values under conditioned laboratory are more precise than the normal condition and also, and testing results can be compared between different laboratories. The value of measurement uncertainty helps to make a decision of pass or fail of the quality of the product. The data collected by person via testing and data do not older than 1 year, then the uncertainty type called as type A. The type B uncertainty depends on the data are collected from the other materials such as calibration report, manufacturer's guide or the data older than 1 year. This research was mainly focused to determine the measurement uncertainty of physical testing of textiles for the requirement of the ISO/IEC 17025: 2017 standard. Firstly, a study was done about the ASTM D and ISO standards of the physical testings of textiles. Then the standard test methods for physical testings of textiles such as Tensile strength, tearing strength, bursting strength, Stretch & Recovery tests were selected. After that a study was done about the sources of uncertainties & main sources of uncertainties of each standard test method were identified. Specimens that are needed to obtained the results were prepared. In here specimens were prepared for the both directions (warp and weft) of the fabric. Five specimens were used for each direction of each test by each person. Results for each test method were obtained by three operators. CRE machine, Digital Elmendorf machine and Auto burst hydraulic tester machines were used to obtain the results. In here tests were done according to the ASTM D and ISO standard methods. Then the standard uncertainty, combined uncertainty, expanded uncertainty of each test method were calculated. According to this study the results show a high deviation due to the effect of the resolution of the machine & skills of the operator.

Keywords: *Measurement uncertainty, expanded uncertainty, combined uncertainty, standard uncertainty, Physical testing*

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Story Behind the Theme

Currently, we, Sri Lankans, are facing several issues mainly due to the unstable economy in Sri Lanka. People come up with various innovative solutions to find solutions to these problems. In particular, young researchers tend to develop novel answers to the issues they are currently dealing with. But none of these has received adequate backing and support to reach the industrial level. Therefore, as Industrial Scholars, we wish to inspire young scientists to support other professionals in the process of building a country with a stable economy.

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"No country can really develop unless its citizens are educated. Any nation that is progressive is led by people who had the privilege of studying"

-Nelson Mandela-

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