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ORAL PRESENTATION

1. CAFEi2023: 035-034

DESIGN CONCEPT OF SMART HERBICIDE SPRAYING MOBILE ROBOT FOR INDOOR FARMING

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ABSTRACT

Nowadays, weeds control in indoor farming is among the operations that is still having a great deal to be optimized for better efficiency. This an unwanted crop still can grow rapidly and create competition with the main crop for water, light, soil nutrients, and space although the farming system is undertaken under a closed-environment condition. Like other plant-disturbing organisms, the presence of weeds has negative impacts to the main plant growth in indoor farming. Weeds reduce yields, increase production costs, affect yields and reduce product quality. Weeds also impede the flow of irrigation water, impede the application of pesticides and harbor pathogens. Therefore, weeds control has become an important crop protection operation in indoor farming that deserve a great attention. However, weeds control is a time-consuming and monotonous task. Apart from that, since it is carried out in indoor areas, which characterized by limited space and confined under a space-constrained environment, hence, the utilization of manpower is inefficient since a worker's crowd in limited space can disturb the process of plant growth. As a result, application mobile robot in indoor farming can be regarded as contented weed management strategy in indoor farming. The robot is widely known capable of minimizing human intervention. The robot is also a highly specialized piece of machine that is able to support a variety of tasks at indoor farming. They can evaluate, consider and execute a wide range of tasks to meet the demands of various agricultural tasks. In the light of the above matter, this study aims to develop a design concept of a mobile robot for weeds spraying on polybag-planted seedlings in indoor farming. The CADD (computer-aided design and drafting) software was used to develop 3D conceptual design of the robot system. Software robots were employed to develop the system design of the robot and its respective steps of operation. The required power for the robot maneuverability was also computed in order to be capable of maneuvering in a space-constrained indoor farming environment. The subsequent steps of robot operation from the processing of the captured image and applying the herbicide to the targeted areas was also described.

KEYWORDS

Crop spraying, indoor farming, robots, smart agriculture

2. CAFEi2023: 002-002

DEVELOPMENT AND TESTING OF A TRICYCLE CASSAVA HARVESTER

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ABSTRACT

Cassava crop cultivation and processing provide household food security, income and employment opportunities for hundreds of millions of people across the globe. Mostly it is harvested using manual technique which is tedious, time consuming. The semi-mechanized and the fully mechanized techniques involve machines which are not readily available or highly expensive. A tricycle cassava harvester for the harvesting of cassava tubers was developed and tested. Fundamental design analysis and calculations were carried out, and materials of appropriate strength and size were subsequently selected for the machine components. The components of the machine were prepared, fabricated, and assembled in the Department of Agricultural and Bioenvironmental Engineering Workshop, Federal Polytechnic Bida. The major machine components include a chain and sprocket, a 7.5 kW petrol engine, a frame, a gripping mechanism, a shaker, a lever arm, and wheels. The results of the testing of the machine reveal that all the efficiencies of the machine increased with an increase in speed of operation. The highest lifting efficiency of 98.6% was obtained at a speed of 6.6 km/h, while the highest recovery and harvesting efficiencies of 99.5% and 94.72%, respectively, were obtained at a speed of 5.5 km/hr. The development of this machine will make a significant contribution to the mechanization of cassava cultivation in Nigeria and other countries.

KEYWORDS

Cassava, efficiency, harvester, lifting, recovery

3. CAFEi2023: 002-003

DESIGN, FABRICATION AND TESTING OF A DOUBLE – ROW TRACTOR MOUNTED POTATO DIGGER -CONVEYOR

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ABSTRACT

Potato farmers in Nigeria and other developing countries face a number of difficulties, the most important of which is a lack of appropriate harvesting tools. Farmers who don't have access to proper harvesting equipment use manual instruments like hand hoes and sticks instead, however this method is labor-intensive, tiresome, and time-consuming. To address these issues, a double-row tractor-mounted potato digger that digs potatoes from the ground, raises, and separates them from the ground was developed. The digging blade, conveyor/separator, gear, shaft, bearing, gearbox, and chain are some of the equipment's essential components. Three levels of forward speed (7, 10 and 13 km/h) and three levels of digging depth were used to evaluate the developed digger (10, 15 and 25 cm). The assessment was based on the following factors: the capacity of the field, the efficiency of the harvest, the number of missing or damaged tubers, and wheel slip. According to the study's findings, digging depth and operation conditions speed directly influenced the field capacity. Field capacity ranged from 0.28 ha/h at forward speeds of 7 km/h and 25 cm of digging depth to 0.48 ha/h at forward speeds of 10 km/h and 15 cm of digging depth. A forward speed of 7 km/h and a digging depth of 25 cm resulted in a harvesting efficiency rating of 98.92%, whereas a forward speed of 13 km/h and a digging depth of 13 cm resulted in a harvesting efficiency value of 66.8%. The potato's digging efficiency ranged from 73.5% at a forward speed of 7 km/h and a digging depth of 13 cm to 93.8% at a forward speed of 10 km/h and a digging depth of 25 cm. The equipment performance was greatly impacted by digging depth and speed. Therefore, it is advised to employ the subsequent operating variables: 22 cm of depth and 7 to 10 km/h speed. Compared to manual harvesting, the newly created equipment reduced harvesting time by around 30%. It boosts output and efficiency.

KEYWORDS

Design, digger, harvesting, potato, speed, tubers

4. CAFEi2023: 128-114

EARLY DESIGN OF MECHANISED PINEAPPLE TRANSPLANTER USING PNEUMATIC

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ABSTRACT

Pineapple cultivation involves several operations, in which planting is considered as one of the critical operations. In recent years, the variety MD2 has been cultivated by many farmers due to high demand in both local and international markets. In this project new technique will be proposed, synthesized and developed. The machine will be a self-propelled with one-man operation. The major components will be the planting mechanism and the sucker feed mechanism that will be integrated into an semi-autonomous sucker planting mechanism by soil opener which consist of puncher and digger to allow sucker enter into the seed bed and then compacted with soil. The puncher and digger powered by using pneumatic. The pineapple transplanter was designed with the width of 1074mm and the clearance of 320mm which able to maneuver over the soil bed. From the transplanter animation, it takes 37cm of extending actuator to open the digger 45 degrees. Air compressor provide 8 bar of pressure which is enough to punch the digger into the soil with 4-5 bar. Overall, the design should be able to be fabricated and tested.

KEYWORDS

Design, pineapple planter, sucker planting mechanism, semi-autonomous planter, pneumatic

5. CAFEi2023: 164-140

CORDLESS PALM OIL CUTTER, P-1 FOR SMALL HOLDER'S PLANTATION

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ABSTRACT

Cutting palm oil branches is time-consuming. Cutting the branch takes so much energy. The Malaysian knife sickle cutter requires 18,048 N for the most advanced frond. Harvesting older trees required more personnel. By using petrol-powered palm oil cutters workers suffer from Hand Arm Vibration Syndrome (HAVS) from utilizing motor cutting instruments frequently. The engine generates tremendous vibrations. Potential and kinetic energy is transferred. HAVS causes finger numbness and poor touch sensation. If they persist, they will lose their hand, making workers unproductive. The objective of this paper to create a workable prototype of a cordless palm oil cutter with Radio Frequency, RF for small holder plantations and to test the functionality of prototype. This prototype is called P-1. For this approach, the author used Solidworks to design the primary element, which is the head cover, and 3D print the finished design; next, perform some wiring for the components used in this project; and last, assemble all the components with the head cover pieces. The field testing was carried out at Parit Sulong, Batu Pahat on 8 January 2023. As a results, the physical testing reveals that the specific weight of P-1 is 0.004 kg m-1, compared to 2.11 kg m-1 and 1.45kg m-1 for the prior version of Cantas and Cantas evo, respectively.

KEYWORDS:

HAVS, petrol-powered, Cantas, Cantas evo, P-1, cordless palm oil cutter

6. CAFEi2023: 007-007

KINETICS OF DIMENSIONAL CHANGES OF WHITE GLUTINOUS RICE DURING SOAKING

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ABSTRACT

White glutinous rice (*Oryza sativa var. glutinosa*) needs to soak in water before cooking. Cooking requires water to gel the starch, which is provided by the soaking process. Studies on the changes of dimensions of glutinous rice have been limited due to glutinous rice- water ratios and soaking times. This study was conducted using white glutinous rice of cultivar Siding. A variation in glutinous rice-water ratios (condition A, 1:1.1; condition B, 1:1.3; condition C, 1:1.5) and time (5, 10, 15, 20, 25, 30, 60, 90, 120, 150, 180 min) of soaking was carried out to determine changes in length, width, thickness, equivalent diameter, surface area, and projected area of glutinous rice. The results found that the soaked glutinous rice in condition C had highest increment in dimensional changes compared to conditions A and B. In this study, the kinetic of changes in glutinous rice dimensions during soaking at room temperature was investigated. Dimensional changes in glutinous rice during soaking was described by the Page model. It was found that the experimental data of dimensional changes in three conditions were well fitted with Page model. The dimensional changes of soaked glutinous rice in condition C was the best fitted Page model with the highest R^2 in predictions of length (0.9527), width (0.9881), thickness (0.9945), equivalent diameter (0.9761), and projected area (0.9603) compared to other conditions. It was noted that the Page model is useful for predicting dimensions of glutinous rice at any soaking time.

KEYWORDS:
Dimensions, glutinous rice, kinetic, Page model, soaking

7. CAFEi2023: 022-012

CHARACTERISATION OF PHYSICOCHEMICAL PROPERTIES OF MANGO INFECTED BY *COLLETOTRICHUM GLOEOSPORIOIDES*

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ABSTRACT

Mangoes are highly vulnerable to various diseases, both before and after harvest. Among the fungal diseases affecting mango trees is mango anthracnose that is caused by *Colletotrichum gloeosporioides*. Infected mango fruits typically exhibit dark, sunken lesions and black spots on their skin, which diminishes their quality and leads to considerable losses in the mango market. Therefore, this study aims to characterise the physicochemical properties of Milk Gold mangoes infected with anthracnose disease. The fruits were inoculated with a spore solution of *C. gloeosporioides* (2.62 x 106 cell/ml) and incubated at room temperature (±28 °C) for 7 days. Control fruits were injected with distilled, sterilised water. The progress of the anthracnose disease was evaluated after a 3-day incubation period, and various physicochemical parameters, such as total soluble solids content (TSS), firmness, pH, colour, weight loss, and moisture content (MC) were measured. The results indicated that the anthracnose disease manifested as small black spots after 3 days of storage, and the flesh of the fruit began to rot severely by day 5 of storage. The TSS, pH, weight loss, and moisture content of the fruits exhibited a gradual increase during the study while the firmness of the fruits decreased as the fruits ripened. Notably, all colour parameter values (L*, a*, b*, c* and H*) indicated significant differences between the inoculated and control fruits. These findings suggest that anthracnose lesion development is associated with the appearance of darker colouration in the infected area. Additionally, the anthracnose disease progressed steadily during the storage period, leading to accelerated fruit deterioration. The disease also developed from within the fruit and caused severe damage once it became visible on the fruit skin. Therefore, it is crucial to identify the disease at an early stage to apply the appropriate disease control measures during post-harvest handling.

KEYWORDS

Anthracnose, mango, physicochemical, symptom, post-harvest

8. CAFEi2023: 020-036

COMPUTER VISION FOR MONITORING GLUTINOUS RICE QUALITY DURING STORAGE

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ABSTRACT

Computer vision technology has been shown to be a promising tool for monitoring the quality of glutinous rice during storage. This technology utilizes image processing and machine learning algorithms to extract useful information from images of the sample. In this study, RGB imaging was used to monitor the quality of glutinous rice during storage. The glutinous rice were stored at 50 °C, 60 °C and 70 °C for 3 months. Data collection was conducted every two weeks by using both RGB imaging and reference methods i.e., moisture content, water absorption capacity, colour change and whiteness index. The relationship between the two methods was modelled using an artificial neural network. The results show that RGB imaging can be used to monitor the quality of glutinous rice with accuracy up to 98%. The findings provide useful insight on application of optical imaging for quality evaluation of grain products.

KEYWORDS

Glutinous rice, machine learning, RGB, computer vision

9. CAFEi2023: 060-060

MATURITY LEVEL PREDICTION AND CLASSIFICATION OF LEMON FRUIT (*Citrus limon cv. Montaji Agrihorti*) USING COMBINED REFLECTANCE FLUORESCENCE COMPUTER VISION AND MACHINE LEARNING MODELS

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ABSTRACT

Montaji Agrihorti is a lemon variety developed in Indonesia with the advantage of few seeds and abundant fruit juice. Determining the estimated yield is very important because it can affect the quality of the harvested fruit. Generally, lemon fruit maturity is conventionally determined based on physical observation and based on calculations after flowering, this maturity determination is still subjective and inaccurate. So a standard is needed in determining the maturity of lemon fruit to produce good fruit quality. Computer vision technology can see and analyze like the human eye various studies that allow detecting fruit maturity without damaging the fruit structure. The purpose of this research is to build a prediction model of physico-chemical parameters on lemon fruit maturity based on reflectance and fluorescence digital image analysis using color and texture features using color and texture features. The experimental laboratory method is carried out in two stages, namely destructive tests and non-destructive tests. Destructive tests were conducted by measuring fruit firmness, total soluble solids (brix) and total acidity. The non-destructive test was conducted by taking images of the fruit using fluorescence reflectance-based computer vision. The combination of fluorescence reflectance light sources using color and texture features in image capture can predict the level of fruit maturity. The data that has been obtained is then processed and processed using machine learning algorithm methods including K-NN (K-Nearest Neighbor), SVM (Support Vector Machine), and Random forest. Modeling results obtained high accuracy on RGB image data Random Forest model with min-max scaling obtained training test results of 1.00 and test accuracy of 0.884.

KEYWORDS

Maturity, lemon *Montaji Agrihorti*, computer vision, machine learning

10. CAFEi2023: 127-113

AUTOMATIC COUNTING OF PAULOWNIA TREES USING UAV IMAGES AND TEMPLATE MATCHING TECHNIQUE

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ABSTRACT

Paulownia has gained recognition as one of the swiftest-growing tree species globally and used for medicinal, ornamental and timber purposes. The current conventional method of paulownia tree counting is based on the ground manual survey which is time-consuming. Therefore, the main objective of this study is to develop a suitable model for paulownia tree counting using template matching and UAV imageries. First, the suitable template matching method was identified by comparing the performance of template matching with georeferencing data and template matching with the predetermined size of template image. It is then followed by the development of an automatic paulownia tree detection and counting model using the most suitable template matching technique at 4 different growing stages which are 3, 6, 9 and 12 months old. Results has shown that the template matching with georeferencing data performed better compared with template matching with predetermined size of template image. For different growing stage model, the 3 and 6 months old paulownia tree models perform better compared to the others with an average F1-score more than 85%. Results also revealed that younger paulownia present greater homogeneity in crown morphology thus made it easier for the algorithm to detect paulownia tree at younger age.

KEYWORDS

Template matching, detection; counting, paulownia, performance, growing stages

11. CAFEi2023: 037-018

LIQUID BIPHASIC FLOTATION SYSTEM (LBFS) FOR SEPARATION OF PROTEIN FROM *AZOLLA PINNATA*

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ABSTRACT

The demand for plant-based protein has surged in recent years as consumers prioritize a healthy lifestyle. Industries are now focusing on developing protein extraction systems that offer high recovery yield and efficient separation processes at minimal operational costs while being environmentally friendly. This project specifically targets the extraction of protein from *Azolla pinnata* using a liquid biphasic flotation system (LBFS). LBFS is a promising extraction method that incorporates microbubbles to enhance protein separation efficiency in a liquid-liquid extraction process. Several LBFS processing parameters were optimized in this study, including the solvent type (ethanol and 2-propanol), solvent concentration (75-100%), salt concentration (200-500 g/l), biomass load (100-400 mg), and flotation time (5-15 minutes). These optimizations aimed to achieve high protein recovery yield and separation efficiency. The study's findings revealed that 2-propanol, with its polarity, yielded the highest protein recovery and separation efficiency. Increasing solvent concentration led to higher extracted protein yield due to the greater number of hydroxyl groups per unit volume. Higher salt concentrations promoted the salting out effect, aiding in the separation process by enhancing hydrophobic contact between the protein and water. A higher biomass load resulted in greater protein recovery, while a longer flotation duration improved protein extraction due to lower particle surface tension. However, excessive exposure to vigorous flotation conditions could lead to protein degradation. Based on the study's optimization, the LBFS conditions that yielded the best results were 80% 2-propanol solvent, 400 g/l salt concentration, 300 mg biomass load, and a flotation time of 10 minutes. These conditions resulted in a protein yield recovery of 78.19% and a protein separation efficiency of 79.39%.

KEYWORD

Azolla pinnata; liquid biphasic flotation system; liquid-liquid extraction; plant based protein; protein separation.

12. CAFEi2023: 101-101

ASSESSMENT OF HEAVY METAL ACCUMULATION IN AGRICULTURAL CROPS IN A NICKEL MINING SITE IN AGUSAN DEL NORTE

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ABSTRACT

Heavy metals exist in high concentrations when anthropogenic activity, like mining, occurs. The excessive heavy metal levels in the soil are potentially available for crop intake and may pose a threat to land and water environment pollution, including humans. In this study, heavy metal accumulation in the soil and the edible portions of agricultural plants (roots, leaves, fruits) in the nickel laterite mining site in Tubay, Agusan del Norte, such as the Cr, Cu, Mn, Ni, and Zn, is determined using X-ray fluorescence (XRF) spectroscopy. Soil accumulation of heavy metal is generally above the Maximum Allowable Limit (MAL) by the FAO/WHO. The Cr, Ni, and Zn content in the edible parts of plant samples also showed accumulations above the permissible values, while Cu and Mn are within the limit. The bio-concentration factor revealed a significant accumulation of Zn in papaya (1.797) and pineapple (1.349). The Target Hazard Quotient (THQ) evaluated the noncarcinogenic risks and showed that Cr, Cu, Mn, and Ni were >1, indicating severe health concerns when edible portions of the plant are consumed.

KEYWORDS

Nickel mine, heavy metal accumulation, target hazard quotient, XRF

13. CAFEi2023: 016-028

TIME-TEMPERATURE DEPENDENT MODELLING OF THE THIN-LAYER DRYING KINETICS OF GLUTINOUS RICE

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ABSTRACT

Understanding the grain's response to temperature during the drying process requires careful observation of the drying kinetics. In this study, freshly harvested glutinous rice was dried in hot air under different temperatures: 50 °C, 60 °C and 70 °C and the drying kinetics were monitored throughout the drying process. The experimental data were fitted into five commonly used mathematical models: Newton, Henderson and Pabis, Page, Peleg, and Logarithmic. To further explain the impact of temperature on the drying kinetic model, a secondary model with time-temperature features was developed. The result shows that the initial moisture content of the glutinous rice was 21.5% and it was reduced to 8% in ~5h under 70 °C and the drying time increased progressively with the reduction in the temperature. The effective moisture diffusivity of the grain increased from $1.09 \times 10^{-8}\ m^2$/s to $2.52 \times 10^{-8}\ m^2/s$ as the temperature increased from 50 °C to 70 °C with an activation energy of 41.1 kJ/mol. Compared to other primary models, the Page model had the best performance with $0.999 \leq R^2 \leq 1.00$, and $0.0014 \leq RMSE \leq 0.036$. The secondary model with 99.64 % prediction accuracy is suggested for predicting the drying kinetics of glutinous rice as a function of the time and temperature of the drying process.

KEYWORDS

Sticky rice, dehydration, secondary models, effective moisture diffusivity, activation energy

14. CAFEi2023: 068-043

ENHANCING THE EFFICIENCY OF INFRARED DRYING OF DESICCATED COCONUT THROUGH PROCESS OPTIMIZATION AND VALIDATION

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ABSTRACT

Drying of desiccated coconut is always challenging due to its sensitivity to heat which can reduce its color quality. Hence, this study mainly focused on the application of infrared drying (IR) to dry desiccated coconut in an efficient way without compromising its color quality. The drying process parameters of desiccated coconut on a single mode infrared drying were optimized using Response Surface Methodology with central composite rotatable design (CCRD). With a set distance of 15 cm from the emitter and a radiation power of 600 Watts, a single layer of desiccated coconut that was about 51.35±4.0% wet basis (w.b) was dried to below 3% (w.b). Three levels of drying temperature (50, 60, and 70°C) and three levels of air velocity (1.5, 2.3, and 3.0 m/s) were taken into consideration as independent parameters. The desired responses were drying time, specific energy consumption (SEC), color changes(ΔE) and whiteness index (WI). The selected optimal drying conditions, with the desirability value (D = 0.827), were 61°C drying temperature and 2.2 m/s air velocity. The response of optimal values for drying time, SEC, color changes, and whiteness index were 36.83 minutes, 19.82 kWh/kg, 3.43, and 71.76 correspondingly. Models for prediction of these values had R^2 values of 0.919, 0.950, 0.923 and 0.905 respectively with non-significant lack of fit (p>0.05). Both drying temperature and air velocity were found to have a significant impact on all responses (p<0.05), with drying temperature having a greater influence than air velocity. A variance of less than 2% was measured during testing conducted in triplicate to validate the optimum drying parameters.
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KEYWORDS

Optimization, infrared drying, desiccated coconut, specific energy consumption, color quality

15. CAFEi2023: 021-108

ADVANCING FOOD-DRYING TECHNIQUES: DESIGN AND PERFORMANCE OF A MULTI-LAYERED DRYING RACK

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ABSTRACT
The drying process is crucial in food processing and preservation, impacting various biomaterials, including fruits, vegetables, grains, fish, and meat. This study introduces the Multi-Layered Aqua Mate Dryer (MAMADry), a novel vertical multi-layered greenhouse system designed to optimize the drying process. The closed polycarbonate structure of MAMADry offers protection against external contaminants, while its efficient design reduces drying times significantly compared to traditional sun-drying methods. The study demonstrates MAMADry's effectiveness in achieving faster, controlled, and uniform drying using Water Hyacinth and Giant Salvinia as test samples. The potential energy efficiency and customizability make MAMADry a promising alternative for small-scale farmers seeking economical drying solutions for various agricultural and seafood products.

KEYWORDS
Biomaterials, drying technology, multi-layered drying rack, solar drying

16. CAFEi2023: 052-026

IMPLEMENTATION OF AN IOT-BASED MONITORING SYSTEM TO EVALUATE SOLAR DRYER PERFORMANCE ON MULLET FISH.

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ABSTRACT

Solar drying is a widely used method for food preservation, offering a flexible and environmentally friendly approach. However, traditional open sun drying methods are inefficient and susceptible to losses and contamination. To address these limitations, a home solar dryer with an IOT-based weight monitoring system was developed for drying mullet fish. The solar dryer was constructed using polycarbonate material and divided into two sections: a preparation section and a drying section. An IOT-based weighing system using load cells and an Arduino MKR 1010 board was implemented to monitor the weight reduction of the fish during the drying process. The performance of the solar dryer was evaluated based on weight reduction, temperature, relative humidity, moisture removal rate, and heat transfer. The results showed that the solar dryer achieved higher moisture removal rates (6.75g/hr) and total moisture loss (21.6%) compared to open sun drying which were 5.59g/hr and 17.9% respectively. The weight reduction percentage and moisture removal rate varied depending on the day and relative humidity inside the solar dryer. The developed solar dryer with the IOT-based weight monitoring system provides real-time feedback to workers, improves drying efficiency, and ensures consistent product quality. It offers a promising solution for enhancing food preservation and reducing post-harvest losses in Malaysia and other regions with abundant solar energy.

KEYWORDS

Renewable energy, solar dehydrator, solar dryer, natural convection, mullet fish

17. CAFEi2023: 059-044

APPLICATION OF ARTIFICIAL NEURAL NETWORKS FOR CLASSIFYING EARTHWORMS (*Eudrilus eugeniae*) MOISTURE CONTENT DURING THE DRYING PROCESS

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ABSTRACT

Earthworms (*Eudrilus eugeniae*) have many benefits for the health and animal feed industries. The drying process of earthworms is necessary to extend their shelf life. Moisture content has a crucial effect on determining the activity of microorganisms that cause decomposition. The purpose of this study was to classify the moisture content of earthworms using machine vision and artificial neural networks (ANN) during the drying process. The classification of earthworm moisture level consisted of a wet class with a moisture content above 40%, a semi-dry class with a moisture content between 40% to 12%, and a dry class with a moisture content below 12%. Color features extraction included red, green, blue, hue, saturation, and value. Meanwhile, textural feature extraction included energy, contrast, correlation, and homogeneity. The filter method as feature selection was used to optimize ANN. Sensitivity analysis was carried out by varying the learning functions i.e. traincgb, traincgf, traincgp, traind, trainda, trainingdm, traindx, trainlm, trainnoss, trainrp, and trainscg, activation functions i.e. logsig, tansig, purelin, and hidden layer nodes i.e. 30 and 40. The best ANN modeling in this study was ta hree-layer ANN with the 8-40-3 structure when using a learning rate of 0.1 and epoch of 1000. The optimum learning function was trainlm with the activation function of logsig, logsig, and purelin, respectively. The lowest mean squared error (MSE) value was 0.86058 for validation data and 0.0733 for training data. While the correlation coefficient (R) value was 0.95309 for training data and 0.92962 for validation data.

KEYWORDS

Artificial neural networks, drying process, earthworms, machine vision

18. CAFEi2023: 138-131

EFFECT OF DRYING TEMPERATURE ON THE PHYSICO-CHEMICAL PROPERTIES OF *Lawsonia inermis* L. (HENNA) POWDER

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ABSTRACT

Lawsonia inermis L. (henna) is a flowering plant or shrub native to Africa and southern Asia's tropical and subtropical regions. Henna is widely used for skin decoration, hair colouring, and as a tattooing agent. Henna in the market is usually in paste form, which has a shorter shelf life than henna in powder form. As a result, the aim of this study was to determine the optimal drying temperature for producing henna powder from two different species. Henna leaves were oven dried at temperatures ranging from 35 to 55°C. It was discovered that the drying times established allow the production of powders with low water activity (a_w) values (<0.7), which are within acceptable limits for safe storage. Colour analysis found that both species had the lowest lightness (L^*) and were the darkest in colour when compared to powder at 45 and 55°C. The drying process turned the greenness of fresh henna leaves into redness, with species 2 retaining more of the dried powder's redness than species 1. The yellowness (b^*) was found to be lower at 55°C, whereas 35 and 45°C did not show a significant difference and had nearly identical values. The current study contributes to a better understanding of the effects of different drying temperatures on the physico-chemical properties of henna powders.

KEYWORDS

Henna, powder, particle size, physico-chemical properties

19. CAFEi2023: 091-068

THE USE OF A SMALL CAPACITY FERMENTATION BOX FITTED WITH A STIRRER TO EVALUATE THE IMPACT OF FERMENTATION TIME ON THE CHARACTERISTICS OF COCOA BEANS

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ABSTRACT

One of the world's top producers of cocoa is Indonesia. The lack of processing facilities, lax quality control, and absence of fermentation all have an impact on the variety of cocoa quality. The use of fermentation is one strategy to address the issue of poor cocoa bean quality and little added value at the farmer level. Due to the misconception that fermentation takes a long period, many cocoa producers in Indonesia have thus far only sold wet cocoa beans. Moreover, 40 kilograms of cocoa beans are required for fermentation, but a typical farmer cannot collect 40 kg in a single harvesting season. The optimization of the small-scale fermentation of cocoa beans utilizing a fermentation box with a stirrer requires research, hence this research is required. By using a swirled fermenter box to streamline the fermentation process, this study seeks to increase the quality of cocoa beans. Cocoa pods being harvested from a cocoa plantation in the Kulon Progo region of Central Java. A fermentation box with dimensions of 40 x 40 x 40 cm and a carrying capacity of 25 kg was used for the experiment. At 0, 24, 48, 72, 96, 120, and 144 hours, fermentation kinetics were observed. A wooden box, a stirrer, and an aeration pit make up the reactor's three major components. The fermentation process experiment involved measuring the density, temperature, and yield of the cocoa beans as well as assessing their pH, cut test, and color indication (Lab). The analysis' findings indicate that the temperature achieved was 29.1°C - 51.1°C. The fifth day or 120 hours later is when the temperature reaches its peak. The density tended to remain constant, the Total Soluble Solid (TSS) value declined, the PH value decreased, the color component of L and b increased, while the color component of a decreased. According to the cut test results, the percentage of fully brown-colored cocoa beans increases with longer fermentation times and a higher fermentation success rate. This study demonstrates that fermenting cocoa beans successfully may be accomplished using a fermentation box with a maximum capacity of 25 kg, a stirrer, and aeration holes.

KEYWORDS

Theobroma cacao, quality, physical properties

20. CAFEi2023: 031-061

EFFECT OF INULIN AND XANTHAN GUM ON THE RHEOLOGICAL PROPERTIES AND 3D PRINTING BEHAVIOR OF TARTARY BUCKWHEAT PASTE

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ABSTRACT

Tartary buckwheat, a free-gluten crop rich in flavonoids and polyphenols that can prevent cardiovascular disease and diabetes, has received considerable attention from the public in recent years. This work aimed to investigate the factors affecting the 3D printability of Tartary buckwheat paste and quantify the impact of these factors. A 2 × 3 factor design comprising three levels of inulin (3, 5, and 7 g) and three levels of xanthan gum (XG) (0.2, 0.4, and 0.6 g) was used. The effect of inulin and XG on the rheological properties (flow behavior and viscoelasticity) and 3D printing behavior (printed shape and dimensional printing deviation) of Tartary buckwheat paste were investigated. Compared with the control sample, the addition of inulin and XG increased the viscosity, storage modules (G') and loss modulus (G") of Tartary buckwheat paste. Meanwhile, its loss tangent (tan δ) was decreased. The viscosity, G' and G" increased with increasing XG and decreasing inulin amount. Principal component analysis (PCA) analysis showed that G', G" and consistency coefficient (K) were important in affecting the printability of Tartary buckwheat paste. At the same time, the XG affected its printability more than the inulin. This study also identified the best combination of XG and inulin to facilitate the printing of Tartary buckwheat paste and produce a final product with low printing deviation.

KEYWORDS

3D Printing, tartary buckwheat, xanthan gum, inulin, rheology

21. CAFEi2023: 126-112

AGRIVOLTAIC CHICKEN FARMING AS A SUSTAINABLE SOLUTION IN URBAN COMMUNITY

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ABSTRACT

Agrivoltaic chicken farming is a sustainable and innovative solution for urban communities that aims to combine renewable energy and agriculture. This concept involves the integration of solar panels with chicken farming, allowing for the optimal use of space and resources. The system provides shade for the chickens, reducing heat stress, while also generating renewable energy for the community. This model has numerous environmental and economic benefits where it reduces greenhouse gas emissions, increases food production, and generates renewable energy, creating a circular and sustainable system. The chickens contribute to the production of organic fertilizer, reducing waste and promoting soil health. Additionally, the system provides a source of local, fresh and healthy food for the community, and creates new job opportunities. The Agrivoltaic chicken farming system also provides opportunities for education and community engagement. It can be used as a tool to teach sustainable agriculture, renewable energy, and urban farming to children and adults. By providing access to locally grown food, this model can also promote healthier and more sustainable lifestyles. Based on the great impacts, the first Agrivoltaic chicken farming has been developed in Puchong Solarfarm with 100 units of Day-Old-Chicken (DOC) as field assessment setup. Overall, Agrivoltaic chicken farming is a sustainable solution that addresses multiple challenges faced by urban communities. It offers a unique opportunity to create a more resilient, environmentally friendly, and self-sufficient community.

KEYWORDS

Agrivoltaic food production, chicken farming, sustainable agriculture, renewable energy, solarfarms

22. CAFEi2023: 064-040

A NOVEL APPROACH TO FOOD SECURITY: A CASE STUDY OF A PADDY PLANTATION IN BRUNEI DARUSSALAM.

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ABSTRACT

Population growth, urbanization, a decrease in land availability, and above all, climate change, have impacted the heavy reliance on rice imports in many developing countries where rice is considered a staple food. The dependence on the import of rice is further aggravated by the pandemic situation and the Ukraine-Russia war, leading to high inflation and a serious threat to food security. In Brunei's case, not having enough paddy yield to cater to the population's demand has been one of the major concerns addressed and highlighted by His Majesty. In fact, Brunei Darussalam wants to diversify its resources away from an oil-based economy and increase its agriculture productivity, particularly to achieve self-sufficiency in rice production. However, a lot of efforts are required as rice production is way behind its target due to various reasons. Some of the reasons are due to acidic soils, pests, diseases, irrigation, climate change, and a lack of human resources. Besides, Brunei Darussalam has to rely on the import of seeds from other countries. This study addresses the problems by adopting technology in the planting of paddy in a controlled environment with the intention of sustainably producing its own seed stock. The objectives of this study are to (i) find a suitable media apart from soil, (ii) apply an innovative approach to grow paddy using a hydroponic system, and (iii) produce top-quality seed for paddy under a controlled environment. The outcome of this study is expected to set up the conditions and controlled environment required for a successful pilot study of growing paddy using vertical rice farming (VRF). The outcome of this study is expected to increase the self-sufficiency in paddy seeds availability to address food security in Brunei Darussalam, especially after the region was hit by the pandemic.

KEYWORDS

food security, IOT, controlled environment, paddy, plantation

23. CAFEi2023: 096-076

RAPID DETECTION OF PORK ADULTERATION IN BEEF AND MUTTON USING FOURIER TRANSFORM INFRARED (FT-IR) SPECTROSCOPY

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ABSTRACT

The adulteration of pork in beef and mutton is a significant concern for consumers, as it may lead to religious, ethical, and health-related issues. Therefore, it is crucial to have a reliable and efficient method to detect pork adulteration in meat products. Accurately detecting pork adulteration in beef and mutton is critical for ensuring product quality and safety. Fourier Transform Infrared (FT-IR) spectroscopy is a powerful analytical technique that identifies specific chemical bonds in different meats based on their unique infrared spectra. This study aimed to develop a model for detecting the adulteration level of pork in beef and mutton using FT-IR spectroscopy combined with partial least squares regression (PLS-R). Spectral data were collected from samples of pure beef, pure mutton, pure pork, and mixing pork with beef or mutton at different levels of adulteration from 1, 3, 5, 7, 10, 15, 20, 30, 40, 50, 60, 70, 80, 85, 90, 93, 95, 97, and 99%. All acquired spectra were compiled in Microsoft Excel and imported into The Unscrambler® X software for multivariate analysis. Several preprocessing methods, such as Normalization, Standard Normal Variate (SNV), Multiplicative Scatter Correction (MSC), and the 1st and 2nd Savitzky-Golay Derivative methods, were used. The results showed that the PLS-R model had good predictive ability in predicting the concentration of pork in beef and mutton. The model performance gives the low root mean square error values (RMSEP = 8.09%) and a high coefficient of determination values (R^2 = 0.960) by using the 1st Savitzky-Golay (SG) derivative method for the beef + pork data and RMSEP value of 12.4% and R^2 value of 0.90 by using the 2nd Savitzky-Golay (SG) derivative method for the mutton+ pork data. Overall, FT-IR spectroscopy combined with PLS-R could accurately detect pork adulteration levels as low as 1% in beef and mutton.

KEYWORDS

Authentication, adulteration, beef, FT-IR, mutton, PLSR, pork

24. CAFEi2023: 049-025

EFFECTS OF MIXING-GRINDING PARAMETERS ON THE QUALITY ATTRIBUTES OF HERBAL (COSMOS CAUDATUS) DRINK POWDERS

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ABSTRACT

Herbal food and beverages consumption is increasing as people become more health conscious and aware of herbal benefit for overall well-being. However, herbal beverage products are limited and not for everyone. Generally, instant herbal coffee is not suitable for adolescent and laxative intolerance consumers. Thus, this project focuses on developing chocolate-based herbal (*Cosmos caudatus*) drink powder by employing response surface methodology to obtain the optimum grinding conditions. Herbal (*Cosmos caudatus*) drink powder samples were ground at different loading mass range from 300g to 900g, at speed 3000rpm to 3600rpm for 15 second to 45 seconds. These variables were used as independent variables whose effects on powder properties and reconstitution time. From the response surface methodology analysis, the recommended grinding condition from the study was found to be at loading mass of 900g and at speed of 3300rpm for 15 seconds. Optimized *Cosmos caudatus* drink powder was compared with commercialized control sample (instant coffee); where the comparison shows, there is significant difference of Carr index and particle size. The difference of Carr index value between optimized *Ulam Raja* drink powder to the control sample are 57.56%. The control sample had a larger particle size of 215 µm, small Carr index and Hausner ratio of 9.23 and 1.11, respectively which results in excellent flowability. The particle size, Carr index and Hausner ratio for optimized *Ulam Raja* drink powder was of 143µm, 21.75 and 1.28, respectively. This shows the optimized herbal drink powder has passable flowability. In general, herbs have been used for centuries for improving and maintaining health. This study provides information on functional drink powder that is both safe and healthy for people of all ages to drink.

KEYWORDS

Herbal drink, powder, mixing, grinding, *Cosmos caudatus*

25. CAFEi2023: 065-039

STORAGE STABILITY OF ELECTROLYZED OXIDIZING WATER AND ITS PROPERTIES AFTER WASHING HONEYDEW FRUITS

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ABSTRACT

Electrolyzed water (EW) has been known as a novel disinfectant, which is generated from the electrolysis of NaCl solution. Reaction at the anode will produce Acidic Electrolyzed Water (AEW), while reaction at the cathode will form Alkaline Electrolyzed Water (AlEW). AEW is used for sanitizing and disinfecting because of its antimicrobial properties and AlEW is used for cleaning. However, EW properties degenerate quickly if it did not appropriately store. Its properties also will change after contact with organic material. Hence, this study investigated the best storage condition for EW and the degradation of AEW properties after being used to wash honeydew fresh-cut. The EW was stored in 4 different conditions (open-light, open-dark, closed-light and closed-dark). The data were taken within 15 days of storing period. Findings show that EW properties were significantly degraded after open-light storage. The effect of honeydew fresh cuts on AEW antimicrobial properties was investigated at several combinations of parameters (mass of fresh cuts, immersion time, and volume of AEW). Antimicrobial properties were gradually decreased after contact with honeydew fresh cuts. Even though the high reduction of the antimicrobial properties was recorded at the high mass of fresh cuts and the longest immersion time, the antimicrobial properties are still acceptable for sanitizing application.

KEYWORDS

Food safety, sustainable sanitation, cleaning, disinfection, minimal processing

26. CAFEi2023: 026-051

OPTIMIZATION OF NON-THERMAL ULTRASONICATION PROCESS FOR RETAINING NUTRITIONAL QUALITY IN MILK: EFFECTS OF FAT PERCENTAGE AND PROCESSING PARAMETERS

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ABSTRACT

The thermal unit operation used in milk processing causes changes in milk nutritional quality. As a result, optimizing the non-thermal ultrasonication process at lower temperatures can be a potential technology to retain milk quality. The purpose of this study is to optimize the ultrasonication process of standardized fresh cow's milk at various fat percentages and elucidate its effect on nutritional values. A central composite design based on fat (1-4%), ultrasound amplitude (10-70%), and sonication time (1.5-10.5 min) was used. Data analysis shows that the ultrasonication process significantly ($p<0.05$) affects the percentage of fat, free fatty acid (FFA), protein, solid non-fat (SNF), lactose, casein, and total solid (TS). The adjusted R-squared for fat, free fatty acid, and total solid with goodness-of-fit were 0.940, 0.975, and 0.955 respectively. Milk proteins and fat within the milk systems may induce the production of volatile compounds. Therefore, the processing parameters to get the highest fat % and lowest FFA % is on a combination of 4.0% milk fat, 10.0% amplitude, and 1.95min sonication time with a density power of 15.63 kJ/L.

KEYWORDS

Dairy milk, high-power ultrasound, non-thermal processing, nutritional quality, central composite design

27. CAFEi2023: 056-033

EVALUATION OF GALLIC ACID FROM *PIPER BETLE* LINN LEAVES EXTRACT: A SUBCRITICAL WATER HYDROLYSIS STUDY

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ABSTRACT

This study aims to evaluate the gallic acid content in *Piper betle* Linn (betel) leaves hydrolysate recovered by subcritical water hydrolysis (SWH) under different process conditions and propose the mechanism for gallotannin hydrolysis. SWH was performed under various operating conditions (temperatures from 100 to 275°C and times from 5 to 30 minutes) using a randomized complete block design. Gallic acid was determined using high performance liquid chromatography (HPLC) with a UV detector. Temperature, time, and the interaction of temperature and time have a significant impact on the gallic acid concentration. When one molecule of gallotannin was hydrolyzed, ten molecules of gallic acid and one molecule of glucose were formed. The highest concentration of gallic acid, 0.522 mg/g, was obtained at 175°C for 20 min in this study.

KEYWORDS

Betel leaves, subcritical water hydrolysis, operation condition, gallic acid, HPLC

28. CAFEi2023: 040-115

BIOACTIVE COMPOUNDS RECOVERY FROM *MORINDA CITRIFOLIA* LEAVES USING CITRIC ACID-CATALYZED ULTRASONIC EXTRACTION

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ABSTRACT

Citric acid-catalyzed ultrasonic extraction is one of the emerging methods of extracting bioactive compounds in plants including *Morinda citrifolia* leaves. The ultrasonic extraction method offers a shorter operating time, reduces solvent consumption, and is environmentally friendly. This study was conducted to determine the effect of processing parameters citric acid concentration (0.1% w/v, 0.55% w/v, and 1.0 % w/v), extraction time (1 min, 6 min, and 11 min), and power of extraction (1.5 W, 57 W, 112.5 W) which affects the citric acid-catalyzed ultrasonic extraction and to study the effectiveness of this ultrasonic extraction method in extracting bioactive compounds from *Morinda citrifolia* leaves. This study used an ultrasonic extraction method using citric acid as a catalyst and the effect of processing parameters were tested upon antioxidant activity analysis, Total Phenolic Content (TPC), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and Ferric Reducing Antioxidant Power (FRAP) assay. Based on the study, citric acid concentrations (% v/v), extraction time (min), and power of extraction (W) had a significant effect ($p<0.05$) on the DPPH. The time and the power of extraction also showed a significant impact ($p<0.05$) on the FRAP analysis. However, for TPC, only the citric acid concentration and extraction time affected the TPC values, meanwhile, the extraction power did not affect the TPC.

KEYWORDS

Morinda citrifolia, bioactive compounds, ultrasound extraction, total phenolic content, antioxidant

29. CAFEi2023: 117-093

EXTRUSION-BASED 3D FOOD PRINTING: PRINTABILITY ASSESSMENT ON THE EFFECT OF PROCESS PARAMETERS OF WHITE CHOCOLATE

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ABSTRACT
An important aspect of 3D food printing is printability, which is one of the critical parameters to judge the success of an extrusion-based 3D printing process. The printability characteristics includes effect of the dead zone/static zone, analysis of die swell, extrudate stacking and rheology behavior of extruded food. In this study, white chocolate was used with a commercial syringe-based 3D food printer. Rheological study of white chocolate was studied using a rotational rheometer under the flow peak hold mode. The results revealed that process parameters such as temperature, extrusion speed and type of nozzle were critical for successful printing of white chocolate. For better printability, appropriate process parameters need to be applied. Hence, this paper focuses on identifying the process parameters including temperature, extrusion speed and type of nozzle used that will affect the printability performance of white chocolate. Further optimization of these parameters enables the food 3D printer to create 3D chocolates with appropriate quality.

KEYWORDS
Extrusion, 3D food printing, printability, process parameters, white chocolate

30. CAFEi2023: 107-098

THE EFFECT OF GREEN SPINACH (*AMARANTHUS VIRIDIS L.*) CONCENTRATION TOWARDS PHYSICO-CHEMICAL CHARACTERISTICS OF SHIRATAKI NOODLES MADE FROM PORANG FLOUR

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ABSTRACT

The occurring challenge in shirataki noodle production is low micronutrition content, unappealing colour and mushy texture. Shirataki noodles' high fibre yet low nutritional content can be fixed by adding green spinach, while calcium hydroxide can fix the noodles' mushy texture. The purpose of this research is to determine the effect of green spinach and calcium hydroxide towards shirataki noodles' physico-chemical traits. This research uses randomized block design with two factors that consists of green spinach and calcium hydroxide concentration (1%, 2% and 3% concentration). Based on research results, green spinach and calcium hydroxide concentration has an effect towards shirataki noodles' physico-chemical traits. Best results is achieved on 3% green spinach and 3% calcium hydroxide concentration, achieving water content of 94.10%, water absorption rate of 86.04%, lightness of 46.27, -a* colour space of -3.46, b* colour space of 30.08, hardness value of 60.77 g, 1% of deformation, 0.55 cohesiveness value, 1.07 mm springiness value, 33.30 g of gumminess value, 0.36 mJ of chewiness value, 0.45 mg of iron content and 21 kcal of calories per 100 gram serving size.

KEYWORDS

Green spinach, calcium hydroxide, texture

31. CAFEi2023: 141-121

DEVELOPMENT AND QUALITY EVALUATION OF ASAM LAKSA-FLAVORED MUSHROOM SNACKS PREPARED BY AIR FRYING

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ABSTRACT
Snacks are well-known among consumers and come in a variety of forms. However, the available snacks in the market are mostly high in calories, fats, salt, and sugar, but low in dietary fiber and nutrient content. In the present study, a novel and healthy asam laksa-flavored mushroom snack was developed by air frying at 165 °C for 6 mins (S1), 8 mins (S2), and 10 mins (S3), respectively. Three different types of mushrooms were used in the formulation, namely shiitake mushroom (*Lentinula edodes*), enoki mushroom (*Flammulina filiformis*), and oyster mushroom (*Pleurotus ostreatus*). A sensory evaluation was conducted with 76 panelists to assess the consumer preference towards all mushroom snack formulations. The most preferred formulation was subjected to nutritional and mineral analysis. In the sensory evaluation, S3 (165 ºC; 10 mins) reported the highest scores for all sensory attributes (appearance, smell, taste, texture, and overall acceptability). The results showed that S3 significantly ($p < 0.05$) increased the protein (7.00%), potassium (143.38 mg/100 g), and magnesium content (4.09 mg/100 g), while significantly lowered ($p < 0.05$) the fat content (2.91%) in comparison to the control sample. This study's results suggest that it is a promising way to produce asam laksa-flavored mushroom snacks through air frying as a healthier alternative to traditional snacks.

KEYWORDS
Mushroom, snacks, air frying, sensory evaluation, nutrient composition

32. CAFEi2023: 147-128

THE CRUST FORMATION AND CONDUCTIVE HEAT TRANSFER COEFFICIENT RELATIONSHIP OF IN-HOUSE FORMULATED DOUGH IN THE DEEP-FRYING PROCESS

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ABSTRACT

Fried starchy products comprise physicochemical reactions, starch gelatinization, water vaporization, protein denaturation, and crust formation. Improper heat transfer in the frying process may ruin the fried food as converting a starchy product from raw to cook can contribute to acrylamide formation when overcooked and causes a high GI index due to crust formation. Therefore, a protective layer that consists of methylcellulose batter is proposed to overcome the issue. To scientifically addressed the fried food processing problem, the conductive heat transfer coefficient of in-house formulated dough was measured by subjecting three samples of keropok lekor, churros and mochi rice cake prepared from Sago flour, wheat flour and Glutinous flour into deep-fry oil from 170-180 oC. It was found that the heat transfer coefficient of all dough was inversely proportional to the dough viscosity. Therefore, the optimum heat transfer coefficient of all formulated dough must not exceed to prevent the over-fried or thick crust layer of all samples.

KEYWORDS

Deep-fried, sago flour, wheat flour, glutinous flour, crust formation, conductive heat transfer coefficient heat transfer

33. CAFEi2023: 075-063

HEALTH RISK ASSESSMENT OF ARSENIC AND IRON IN COMMERCIAL WHITE AND BROWN RICE IN MALAYSIA

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ABSTRACT

To this day, rice remains one of the world's most indispensable agricultural commodities, nourishing nearly one-half of the global population. Rice, though vital to our diets, can be vulnerable to nutrient deficiencies and contamination. This study determined the arsenic (As) and iron (Fe) concentration in commercial white and brown rice marketed in Malaysia and their potential health risks. Concentrations of As and Fe varied significantly across both locally produced and imported rice brands. Mean concentrations of As and Fe across all rice samples were 0.229±0.063 mg kg^{-1} and 7.872±5.756 mg kg^{-1}, respectively. Almost 60% of the white and 13% of the brown rice samples exceeded the CODEX permissible limits for As, but none exceeded the limit of Fe by WHO. However, none of the rice samples met the European Union's standard for use in infant foods with respect to As levels. The daily intake of Fe was five times lower than the recommended dietary uptake suggesting insufficient Fe contribution through rice consumption. The results of this study show that, regular consumption of white rice may put people at risk for As exposure and the ensuing non-cancerous and malignant health problems. Arsenic contributed 98% to the hazard index, which measures the risk of non-carcinogenic risk. Conforming to the ILCR, all rice samples had a high carcinogenic risk (>10^{-4}), suggesting that they might cause cancer. For this reason, it is essential to monitor rice grains available commercially, in addition to taking promising alleviation and enrichment initiatives to produce safer, more wholesome rice grains.

KEYWORDS

Oryza sativa, arsenic, iron, health risk assessment

34. CAFEi2023: 161-138

INVESTIGATION OF THE REMOVAL OF METHYLENE BLUE DYES FROM AQUEOUS SOLUTION USING A CHITOSAN NANOCOMPOSITE MEMBRANE

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ABSTRACT

The removal of methylene blue dyes from aqueous solutions is a significant environmental concern due to their persistence, toxicity, and adverse effects on ecosystems. In this study, we investigated the performance of a flat sheet nanocomposite membrane for the removal of methylene blue dyes from aqueous solutions. In this study, chitosan nanoparticles (NPs) were incorporated into the membrane dope matrix. The structural properties, functional groups, and elemental constituents of the NPs based on FTIR, EDX, and XRD analyses will be carried out to demonstrated that chitosan NPs is successfully incorporated. Then, pristine polyvinylidene Fluoride (PVDF)-Polyethylene glycol (PEG) based membrane and composite membrane blended with chitosan NPs will be fabricated via non-solvent induced phase inversion (NIPs) technique. The resultant fabricated membranes will be analyzed by the contact angle, FESEM, EDX, surface zeta-potential, porosity, flux, resistance to fouling, and dye rejection. It is expected that the results will demonstrate that the nanocomposite membrane exhibited excellent capacity and efficiency for the removal of methylene blue dyes. The findings of this study will highlight the potential of the flat sheet nanocomposite membrane as an efficient material for the removal of methylene blue dyes from aqueous solutions. This study contributes to the understanding of the removal mechanism behavior and performance of nanocomposite membranes and provides valuable insights for the development of advanced water treatment technologies. The application of nanocomposite membranes in wastewater treatment could significantly contribute to mitigating the environmental impact of dye pollutants and ensuring the availability of clean water resources.

KEYWORDS

Nanocomposite membrane, flux, methylene blue, polyvinylidene fluoride, chitosan nanoparticles

35. CAFEi2023: 085-056

MITIGATING 3-MONOCHLOROPROPANE-1,2-DIOL ESTERS AND MINERAL OIL HYDROCARBON (MOH) CONTAMINANTS IN PALM OIL PRODUCTION THROUGH HOT WATER DILUTION

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ABSTRACT

The contamination of 3-MCPD esters and mineral oil hydrocarbon (MOH) in palm oil can occur during the dilution process of the crude palm oil (CPO). The use of steriliser condensate (SC) and empty fruit bunch liquor (EFBL) as dilution solution is commonly practiced in the palm oil milling industry for water conservation and oil recovery. However, they may contribute to CPO contamination and deterioration. This study aimed to investigate the effects of different dilution solutions on MOH contamination, CPO quality, and 3-MCPD esters formation in both CPO and refined bleached deodorised palm oil (RBD PO). Undiluted crude oil was treated with various dilution solutions (SC, EFBL, and hot water) at 30% dilution rate, and the resulting CPO was evaluated for mineral oil saturated hydrocarbon (MOSH) and quality parameters (total chloride, free fatty acid, DOBI, and iron content). The formation of 3-MCPD esters was assessed in the RBD PO. The findings revealed that the use of SC significantly contributed to the MOSH level in the CPO, with concentrations of 38.2 mg/kg and 26.6 mg/kg when diluted with SC and a mixture of SC and EFBL, respectively. The MOSH levels extracted from SC was 11 times higher than that from EFBL, at 374.20 mg/kg and 33.90 mg/kg, respectively. Substituting the dilution solutions with hot water significantly reduced MOSH in the CPO, reduced total chloride content by 35%, and 3-MCPD esters formation by 33% at 0.5 mg/kg, and improved CPO qualities. In conclusion, hot water dilution is the recommended dilution solution for both safety and quality measures.

KEYWORDS

Crude palm oil (CPO), empty fruit bunch liquor (EFBL), mineral oil saturated hydrocarbon (MOSH), steriliser condensate (SC)

36. CAFEi2023: 046-082

EFFECT OF SONICATION TIME ON PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF PURPLE SWEET POTATO STARCH AND PEEL-BASED PH INDICATOR FILMS

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ABSTRACT

Like other starch films, starch-based pH indicator films require improved properties because of their poor mechanical and hydrophobic properties, swell easily in water, and are more sensitive to humidity. Therefore, this research aimed to investigate the effect of sonication time as a physical treatment on the properties of sweet potato starch and peel-based pH indicator films. Purple sweet potato starch (SPS) and sweet potato peel (SPP) was used to fabricate two types of pH indicator films, where commercial purple sweet potato anthocyanin (CA) was incorporated as an indicator dye and glycerol as a plasticiser. The SPS and SPS/SPP (6:4) film formulations sonicated for 10 min to remove air bubbles are control films. For the treated films, different sonication times of 15 min, 30 min, 45 min and 60 min were implemented, and the physicochemical and mechanical properties of the films were investigated. The result demonstrated that the SPS/SPP films were thicker than the SPS film, and for both films, the thickness of the treated films was significantly higher than the control films. The water content (WC) and water solubility (WS) for SPS films were reduced with 30, 45 and 60 min of sonication. However, for SPS/SPP films, a significant reduction in WC and WS was found in all treatments. For both films, 60 min sonication time possessed the lowest WC in SPS (8.77± 0.02%) and SPS/SPP (6.20 ± 0.50%) films. A sonication treatment time of 45 min and 30 min showed the lowest WS in SPS films (50.21 ± 0.92%) and SPS/SPP films (73.81± 1.56%), respectively. The SPS films and SPS/SPP films appeared purple and maroon and became darker as the sonication time increased. The colour coordinators (*L*, *a*, and *b*) and total colour difference (ΔE) values indicated the colour differences in the visual appearances of the films. A significant colour change in contact with pH 1 to 12 proved that the sonication treatment did not affect the film's pH-indicating ability. A significant increment was observed in the tensile strength (TS) of the SPS films for 30, 45 and 60 min of sonication, where 45 min of sonication caused the highest tensile value (16.23±0.81 MPa). For SPS/SPP, films sonicated for 30 and 45 min showed improved TS, and the highest value (4.38±0.34 MPa) was obtained after 30 min of sonication. With higher sonication time, the elongation at break (EaB) statistically decreased for SPS films and increased for SPS/SPP films compared to the control film. The highest EaB values were assessed for SPS control film (63.59±2.68%) and SPS/SPP films

treated with 45 min of sonication time (36.87±2.85%). The results revealed that sonication time significantly improved the film's mechanical and physiochemical properties for food packaging.

KEYWORDS
Sweet potato starch, pH indicator, sonication time, physicochemical properties, mechanical properties.

37. CAFEi2023: 045-067

NANOENCAPSULATION OF THYMOL IN CHITOSAN NANOPARTICLE ON POLY (LACTIC ACID)/ POLY (BUTYLENE SUCCINATE)/NANOFIBRILLATED CELLULOSE (PLA/PBS/NFC) FOR ACTIVE FOOD PACKAGING APPLICATION

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ABSTRACT

Active packaging has extensively been reported for its food shelf-life extension, biodegradability, and minimizing the disposal of solid waste. Essential oil (EO) can be applied as an active agent due to its high antibacterial, and antioxidant properties, but due to its sensitivity to certain conditions such as high volatility, oxidation susceptibility, and degradation at high temperatures has limited its applications. Nanoencapsulation has emerged as a method to address the limitations of essential oil. In this work, 4 wt% of thymol essential oil nanoparticles (CNP-T) were prepared and incorporated as active agents into poly (lactic acid)/poly (butylene succinate)/nanofibrillated cellulose (PLA/PBS/NFC) films. The prepared samples were characterized on mechanical properties, chemical interactions, and toxicity levels. The CNP-T presented monodispersed sizes from 23- 49 nm with spherical shapes. The 4 wt % of TEO-CNPs improved the films' mechanical properties, which can be associated with strong interactions between the materials. Finally, to establish the possible toxicity effect of the PLA/PBS nanocomposites obtained, studies *in vitro* were performed in macrophage cells. Toxicity studies showed after 48 hours, PLA/PBS/NFC with 6% CNP-T exhibited 74% viability cells which can be considered safe. The films showed good potential for food packaging application, being an alternative to conventional packaging's environmental problems.

KEYWORDS

Bionanocomposites, chitosan nanocapsules, poly(lactic acid), poly (butylene succinate), thymol essential oil

38. CAFEi2023: 120-141

CONTROLLED RELEASE AND ANTIBACTERIAL ACTIVITY OF CORN STARCH-BASED FILMS CONTAINING NANOCELLULOSE AND THYMOL

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ABSTRACT

This work aims to investigate the migration of thymol from corn starch (CS) and corn starch-based films containing nanocellulose fiber (NCF) into a food simulant. Thymol was successfully identified in the film structure via microscopic and spectroscopic techniques. A kinetic study was performed to evaluate the release of thymol from the films into a fatty acid food simulant (ethanol 95% v/v) at 40 °C. The antibacterial activity of the films was investigated via liquid culture assay. The release of thymol was affected by the presence of an intercalating network of NCF, which showed Fickian diffusion behavior. Antibacterial activity against *Listeria monocytogenes* and *Salmonella typhimurium* demonstrated that CS/NCF/Thy film had a greater inhibitory effect compared to CS/Thy film. The findings prove the potential applications of the films to improve the shelf life of perishable food products.

KEYWORDS

Kinetic release, thymol, nanocellulose fiber, starch, active packaging

39. CAFEi2023: 100-083

EVALUATION OF STATIC AND DYNAMIC ARRANGEMENT OF LIGHT EMITTING DIODE (LED) ON ROCKMELON GROWTH

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ABSTRACT

Light is one of the important environmental factors and energy sources for growth and production, and the effectiveness of indoor farming depends mainly on lighting qualities. The light's distance can affect the light's intensity; as the light source is closer to the plant, the light intensity increases. It is crucial to determine the proper distance of light emitting diode (LED) lighting because moving the grow light closer will maximize photosynthesis. However, little attention has been seen on investigating the light distance effect on plant growth. The main objective of this study is to evaluate the static and dynamic arrangement of LED on rockmelon growth. Two different treatments are conducted to investigate the effect of light arrangement on rockmelon growth: static treatment and dynamic treatment. The difference between these treatments is the arrangement/distance of growing light is fixed from the beginning until the harvesting process for static treatment while for dynamic treatment the distance will vary based on the height of the plant and its growing requirement. Dynamic treatment showed better results where it has 19.87% higher tree height, 22.93% wider leaf, 28.74% more leaf number, and 11.62% higher chlorophyll content than static treatment. This study provides insight into the effect of light arrangement and distance on light intensity and distribution.

KEYWORDS

Light intensity, LED, light arrangement, rockmelon, static treatment, dynamic treatment.

40. CAFEi2023: 133-134

EFFECT OF HYDROGEN PEROXIDE AND SODIUM ALCOHOL ETHER SULPHATE ON THE COMPRESSIVE STRENGTH AND TOTAL POROSITY OF POROUS RICE HUSK ASH-BASED GEOPOLYMER FOAM

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ABSTRACT

Rice husk is the common solid waste generated during rice processing, and it is typically processed into rice husk ash (RHA). It is typically disposed of by open combustion or discarded in landfills. Although it was used to develop ceramic material, the study on porous geopolymer foam using rice husk ash is rather limited. Besides, a thorough study in obtaining the optimum formulation for rice husk ash-based geopolymer foam has never been performed despite its excellent thermal properties. The objective of the study is to determine the effect of hydrogen peroxide and sodium alcohol ether sulphate (SAES) on the properties of porous rice husk ash-based geopolymer foam. The porous geopolymer foam was prepared by mixing sodium silicate, sodium hydroxide, rice husk ash, genioperl, hydrogen peroxide, and stabilizer at a designated ratio. Two factors were studied namely hydrogen peroxide (0.0, 0.1, 0.2, 0.3, and 0.4 wt.%) and SAES (0.0, 0.5, 1.0, 1.5, and 2.0 wt.%). Testing on compressive strength and calculating the total porosity was performed based on standards (ASTM D695). The results showed that increasing the hydrogen peroxide resulted in an increase in total porosity and a decrease in compressive strength. Total porosity and compressive strength decrease as the amount of SAES increases. The

optimum total porosity and compressive strength could be achieved when hydrogen peroxide is 0.40 wt.%, and the SAES is 1.0 wt.%. In general, the properties of RHA-based geopolymer foam can be enhanced when hydrogen peroxide and stabilizers are added. This material can be used in areas such as buildings, pipelines, and agriculture fields.

KEYWORDS
Geopolymer foam, rice husk ash, hydrogen peroxide, sodium alcohol ether sulphate, compressive strength

41. CAFEi2023: 172-147

ESTIMATING AN *EUCALYPTUS HYBRID (E.GRANDIS X E.UROPHYLLA)* FUEL WOOD AS A BIOMASS SOURCES FOR THE 10 MW DENDRO POWER GENERATION PLANT

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ABSTRACT

This investigation looked into the viability of commercial energy crops for dendro-power plants made from *Eucalyptus hybrids*. This publication presents the findings. Wood fuels are used in dendro-power plants to generate electricity. Thanks to modern technology, using wood in dendro-power plants is effective, long-lasting, and sustainable. The moisture content, physical inspection, and calorific value of various tree kinds were just a few of the calculations and tests that were carried out. The unique plantation built for the development of 10 MW dendro power plants has its *Eucalyptus hybrid* production per square meter estimated. 50 GWh of electricity can be produced annually by a 10 MW dendro power plant, which can either be used for self-consumption or sold to an energy supplier. This work provides a novel quantitative approach for estimating the quantity of wood required to produce dendro power. According to the estimates, the Dendro power plant requires 32,482 tons of fuel annually to run. In order to plant *Eucalyptus hybrids* for the power plant, a total of 706 hectares must be set aside. The annual fuel requirement for the Dendro Power Plant is 768,834 *Eucalyptus hybrid* trees. The execution of this project will also aid in the economic growth of nearby towns, particularly in rural ones.

KEYWORDS

Biomass resources, dendro power plant, energy production, eucalyptus hybrid, fuel woods

42. CAFEi2023: 150-130

MILP MODEL FOR OPTIMAL CONVERSION OF FOOD WASTE INTO POULTRY PELLET

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ABSTRACT

In recent years, food waste generation has received great concern from food producers, suppliers, and consumers. Besides economic losses to the whole supply chain, improper food waste management also contributes to the food security issue. Conversion of food waste into poultry pellet not only reduce the amount of food waste in landfill but is also able to fulfil the expanding demand for animal feed. Therefore, the objective of this study was to find an optimal operation to convert food waste into poultry pellets by using Mixed-Integer Linear Programming (MILP) in General Algebraic Modeling System (GAMS). General Algebraic Modeling System was used as the optimization tool to convert food waste into poultry pellets. The developed model considered several factors such as nutrient composition, cost and price. The developed model can eliminate the production that will contribute to the loss or low profit compared to other products. In this study, the model eliminates the option of using additives in pellets and selects food waste as the new ingredient in the production of poultry pellets. The highest capacity of nutrient composition in poultry pellets is a nitrogen-free extract (NFE) which is 21,326.76 metric tonnes per year, while the lowest is moisture at 691.6 metric tonnes per year. The conversion of food waste into pellets generates a higher annual profit of RM60.13 million than an additive with only RM25.23 million. The developed model verified that the conversion of food waste into the poultry pellet has a high return on investment (ROI) at 81% and a shorter payback period, which is 2.24 years compared to the additive (maize).

KEYWORDS

Optimization model, food waste management, poultry pellet

43. CAFEi2023: 130-117

CHARACTERIZATION AND APPLICATION OF SOPHOROLIPID AS AN ANTIFUNGAL AGENT

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ABSTRACT

Biosurfactants are surfactants produced by bacteria, yeasts and fungi. The current market-trends show that biosurfactants demand was increasing due to its environmentally friendly characteristics and high degree of degradability that can be utilised in many fields such as cosmetics, agriculture, pharmaceutical and food industries. Vegetable fruits such as tomato and chili are very important economic food crops grown worldwide for domestic usage and export. They are easily attacked by diseases which drastically reduce the yield, deteriorates the fruits quality and causes economically losses This study aims to characterize the Sophorolipid and determine its antifungal activity through Poison agar technique and surface coating on tomatoes and chilies. The preliminary results showed that Sophorolipid has significant effect on the inhibition of fungus growth at low concentrations (0.05%-5%) and it is able to prolong the shelf life of crops by preventing the fungus infections. These proved that Sophorolipid has the great potential to be used as a biopesticides.

KEYWORDS

Sophorolipid, tomato, chili, *Fusarium oxysporum sp*, biofungicide

44. CAFEi2023: 097-077

TESTING AND EVALUATION OF NEWLY DEVELOPED HARVESTING BASKET AMONG MALE PINEAPPLE HARVESTERS IN JOHOR, MALAYSIA

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ABSTRACT

This study aimed to evaluate a newly developed harvesting basket used in manual pineapple harvesting work in Malaysia, specifically focusing on its impact on physiological workload, body part discomfort, perception of harvesters, and the risk level of musculoskeletal disorders (MSDs). A cross-sectional study was conducted among pineapple harvesters in Muar, Johor. Data from 25 harvesters were collected using questionnaires, including the Borg CR-10 Scale to assess body part discomfort while using both the newly developed basket and the traditional rattan basket. The physiological workload was measured using Fitbit Fitness Smartwatches to record the heart rate of the respondents and calculate the workload. The risk level of awkward posture during harvesting tasks was assessed using the Rapid Entire Body Assessment (REBA) tool for both types of baskets. The perception of harvesters towards the new basket was evaluated using a modified questionnaire. Descriptive analysis was used to analyse the perceptions of respondents, while paired t-tests and Wilcoxon signed-rank tests were used to compare physiological workload, REBA scores, and body part discomfort between the two baskets. The results revealed workers experienced significant reduction in physiological workload between the use of rattan (6.6 ± 0.9 Kj-min) and prototype basket (5.0 ± 1.1 Kj-min). Harvesters experienced reduced discomfort when using the new basket compared to the rattan basket. The postural analysis using REBA indicated a decrease in the risk level of awkward posture from high (rattan) to medium (prototype) when harvesting. Most harvesters perceived that the new harvesting basket fulfilled their needs. In conclusion, the newly developed harvesting basket demonstrated the potential to improve the work posture, discomfort, and physiological workload of pineapple harvesters, thereby reducing the incidence of musculoskeletal symptoms. The adoption of ergonomically-designed work tools aligns with the MyGAP policy and supports the improvement of workers' health in pineapple harvesting operations.

KEYWORDS

Ergonomic tools; physiological workload; discomfort; awkward posture; pineapple harvesting

45. CAFEi2023: 152-129

COMPREHENSIVE RICE MAPPING USING UAV IMAGERY AND GIS ANALYSIS FOR CROP MONITORING

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ABSTRACT

Unmanned aerial vehicles (UAVs) are widely used in many sectors including agriculture. The study's objectives were to monitor rice fields from comprehensive rice mapping using UAV- based imagery and evaluate the rice map with soil plant analysis development (SPAD) data on the ground. A series of images captured by UAV was used to generate the normalized difference vegetative indices (NDVI) map and reclassification map and Geographical Information System (GIS) analysis. During the first flying session, nearly 93% of the crop area are exhibited a lower value NDVI range of -1 to 0.20. However, this range decreased to 53% during the third flying session. The NDVI range between 0.21 to 0.40 covered approximately 89% of the crop area during the fifth flying session. The results indicate that the NDVI range between -1 to 0.20 once again increased to encompass 95% of the coverage area prior to crop's harvest. Ground sample data shows a positive correlation between NDVI value (mean) and SPAD with r=0.456. This study concludes that a series of the UAV images captured are able to be used to assess the vegetation health by comparing the trend of the NDVI value for each flying session and using it as a reference to determine the focus area for monitoring purposes.

KEYWORDS

Precision agriculture, UAV, NDVI, GIS analysis, crop monitoring

46. CAFEi2023: 102-085

USE OF *KEKE* EMITTER IN DRIP IRRIGATION SYSTEM

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ABSTRACT
Rural farmers in Nigeria barely meet the cost of drip irrigation equipment because it is expensive. They resort to acquiring polyvinyl chloride (PVC) pipes, medi – emitters, syringe and needle etc. as improvised emitters and install in irrigation farms. This study, test the use of a bicycle *(Keke*) air pressure valve as emitter on drip irrigation system. Rural farmers use air pressure valve to inflate their bicycle tubes which is affordable and generally acceptable. The calibration and performance evaluation of the *Keke* emitter was done on a sandy loam soil. The experiment involved the use of the *Keke* emitter to discharge water at 5, 10 and 20 minutes. Discharge were selected randomly and calculated using volumetric method. It was observed that variations in flow volumes along the laterals is small. For the 5, 10 and 20 minutes of applications, the average discharge was calculated to be 5.67, 10.48 and 20.3l/h respectively. Correspondingly, the uniformity coefficient was found to be 96.8%, 97.0% and 98.4% and distribution uniformity 98.4%, 97.9% and 98.3% respectively. The uniformity coefficient was high which describe the emitter as proper on the basis of discharging of water into the field. This is a new dimension in economical drip irrigation technology and way to exploit cheap materials in drip irrigation systems especially for rural farmers in Nigeria and beyond.

KEYWORDS
Drip irrigation, Keke-emitter, improvise, discharge, valve.

47. CAFEi2023: 095-084

APPLICATION OF GIS AND SWAT HYDROLOGICAL MODEL FOR ASSESSING WATER YIELD AT TAGUIBO RIVER WATERSHED FOREST RESERVE (TRWFR), BUTUN CITY, PHILIPPINES

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ABSTRACT

As urban development has progressed, the demand for reliable water supply in the city has increased significantly. However, due to limited suppliers, the availability of sanitary water could be more consistent. Furthermore, the region has experienced heightened occurrences and intensified magnitudes of floods and droughts because of the influence of climate change. Consequently, ensuring an adequate water supply to meet the needs of the growing population has become a pressing concern. Thus, this study aimed to develop a hydrological model utilizing Geographic Information System (GIS) and the Soil and Water Assessment Tool (SWAT) to assess the water yield in the upstream area of the Taguibo River Watershed. The model underwent validation using observed monthly discharge data from 2012 to 2013 after being calibrated from 2010 to 2011. The model calibration yielded satisfactory results, as evidenced by the R2= 0.63, NSI= 0.33, and PBIAS= -29.9%. Similarly, the validation phase demonstrated a strong correlation between the simulated and actual values of the model, with R2= 0.87, NSI= 0.73, and PBIAS= -19%. These findings underscore the effectiveness of integrating the GIS environment and SWAT model for evaluating watershed hydrology and estimating water yield. Overall, this study showcases the potential of GIS and the SWAT model in comprehensively examining the hydrological aspects of watersheds and providing valuable insights into water yield calculations.

KEYWORDS

Hydrological model, geographic information system (GIS), soil and water assessment tool (SWAT), water yield, Taguibo river watershed forest reserve

48. CAFEi2023: 143-123

HYDRAULIC RAM PUMP DEVELOPMENT FOR SMALL IRRIGATION SYSTEM IN UPLAND BARANGAYS

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ABSTRACT

A field-type Testing Rig for evaluating the technical performance of Ram Pump prototypes was established at the Renewable Energy Research Center (RERC) of the Visayas State University. Using the testing rig, the technical performance of one ram pump prototype developed in RERC, was evaluated using a three-factor factorial experiment in a completely randomized design (CRD) with drive pipe angle (H, º), waste valve angle (Θw, º), and delivery pipe size diameter (Ø, in.) as factors. The angles of elevation used were: H1= 5°, H2= 10°,and H3= 15° for the drive pipe; and Θw1 = 34°, Θw2 = 46°, and Θw3 = 59°for the waste valve. The delivery pipe diameter sizes were set Ø1= 1", Ø2= 3/4", and Ø3= 1/2". Results indicated that the combinations of H,Θw, and Ø have significant effect on the water discharge (Q, li/min),vertical height of discharge (h, m), and the pressure build-up inside the air chamber (P, kPa). The parameter combination that gave the highest water discharge of 15.44li/min and a delivery height 6.38m was at H=10º, Θw=34º, and Ø=1". These results revealed that the testing rig can be used for technical performance evaluation of any ram pump prototypes, and the RERC-developed ram pump can be used for small irrigation system for high value crops in areas where electricity is not present.

KEYWORDS

Hydraulic ram pump, technical performance, testing rig

49. CAFEi2023: 146-127

COMPARATIVE EVALUATION OF SUITABILITY ASSESSMENT OF THE TAGUIBO RIVER IRRIGATION SYSTEM DIVERSION DAM

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ABSTRACT

The Taguibo River Watershed and Forest Reserve (TRWFR) is the main source of water consumption and irrigation supply in Butuan City, but the irrigation supply is often insufficient, particularly during dry seasons. Competing demands for water further exacerbate the problem, leading to a reduction in water available for irrigation. This study was conducted to assess the Taguibo River irrigation system diversion dam using the Analytical Hierarchy Process (AHP) and Geographic Information System (GIS) tools. The dependable flow of the diversion dam was investigated to assess the sustainability of water which results in 466.94 lps, and the AHP analysis identified river discharge as the most important factor in suitability assessment. The generated suitability map showed the specific sites suitable for dam construction within the river, covering approximately 88,599.17 m^2 or 0.16% of the study area. The existing suitability map, in contrast, focused on the entire study area and disregarded the river network as a criterion, resulting in a much larger proportion (68%) of the area being deemed suitable. Overall, the study found that the Taguibo River irrigation system diversion dam was highly suitable based on the selected criteria and the current suitability map provides valuable information for site selection and construction.

KEYWORDS

Geographic information system (GIS), analytical hierarchy process (AHP), suitability map, Taguibo river irrigation system diversion dam, dependable flow

50. CAFEi2023: 163-139

CORRELATION OF COCONUT (*Cocos nucifera*) GROWTH PERFORMANCE WITH ENVIRONMENTAL PARAMETERS UNDER RAIN SHELTER NURSERY ON A ROOF TOP GARDEN IN TROPICS

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ABSTRACT

The correlation between coconut (*Cocos nucifera*) growth performance and environmental parameters in a rain shelter nursery located on a rooftop garden in a tropical region was investigated. The study aimed to understand the influence of environmental factors on coconut growth under controlled conditions, simulating the tropical climate. Various environmental parameters, including temperature, humidity, light intensity, and wind speed, were measured and correlated with the growth parameters of coconut seedlings. Coconut seedlings were cultivated in a rain shelter nursery on a rooftop garden to provide a controlled environment that minimized the impact of external factors. The environmental parameters were continuously monitored using appropriate sensors and instruments. Growth parameters, such as plant height, leaf area, and stem diameter, were measured periodically to assess the performance of the coconut seedlings. Preliminary findings indicate a strong correlation between the environmental parameters and coconut growth performance. Temperature and humidity showed a significant positive correlation with various growth parameters, suggesting that maintaining optimal temperature and humidity levels is crucial for promoting coconut growth. The results of this study contribute to the understanding of the relationship between environmental parameters and coconut growth under controlled conditions in a tropical setting. The findings can inform rooftop garden design and management strategies, helping to optimize coconut cultivation and enhance the overall sustainability and productivity of urban agriculture in tropical regions. Further research is recommended to investigate the long-term effects of environmental parameters on coconut growth and to explore additional factors, such as nutrient availability and pest management, that may influence coconut performance in rooftop garden nurseries.

KEYWORDS

Coconut seed, growth performance, environmental parameters, rain shelter, roof top garden, tropics

51. CAFEi2023: 084-062

EVALUATING THE EFFECT OF LOW AND HIGH TEMPERATURE MODE OF SUBCRITICAL WATER PRE-TREATED EMPTY FRUIT BUNCHES ON CO-DIGESTION PERFORMANCE AND KINETIC STUDY FOR BIOGAS PRODUCTION

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ABSTRACT

Anaerobic digestion of palm oil empty fruit bunches (EFB) is considered an effective method for non-renewable energy substitution through biogas production. However, the lignocellulosic recalcitrance structure of EFB is one of the main difficulties in achieving high biogas production for anaerobic co-digestion with palm oil mill effluents (POME). In this study, EFB was pre-treated with subcritical water (SCW) at low (120ºC) and high (180ºC) temperature for 10 to 30 minutes to enhance the biogas production. The characteristics of EFB after SCW pre-treatment were evaluated to identify the changes in physicochemical characteristics such as lignin, volatile solid (VS) and solid yield. The severity of pre-treatment increased from 1.59 to 3.83 in line with the increment in the temperature and reaction time. The solid yield of SCW pre-treated EFB increased at high temperatures and vice versa for the pH of the liquid part. The combination pre-treatment of 180ºC for 10 minutes with 546.18 ml/g VS biogas yield and 421.41mL CH_4/g VS methane yield revealed the highest biogas production. Meanwhile, all co-digestion of SCW pre-treated EFB with POME led to the removal of more than 66% VS. The sugars released were analyzed on the liquid fraction of SCW pre-treated EFB where glucose, xylose, cellobiose, mannose and galactose were detected. Notably, the kinetic study of biogas production of pre-treated EFB using the modified Gompertz model revealed that the pre-treatment had improved the lag phase, and the highest biogas production rate was observed at 19.80 mL/day. The biogas production of pre-treated EFB improved the anaerobic digestion process parameters in terms of

total ammonia nitrogen, VS elimination, and pH when compared to untreated EFB. In conclusion, the co-digestion of EFB with POME can be improved with the use of SCW pre-treatment.

KEYWORDS
Co-digestion, pre-treatment, subcritical water

52. CAFEi2023: 077-050

PERFORMANCE EVALUATION OF *MORINGA OLEIFERA* AS COAGULANT FOR TREATING ABATTOIR WASTEWATER

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ABSTRACT

In this paper, extract from raw *Moringa Oleifera* seeds for the treatment of 40 litres of abattoir wastewater was studied for the period of ten (10) weeks. Completely randomized design with loading dosages of 10, 12, 14, 16, 18 and 20g of processed *Moringa Oleifera* seed was used in the treatment. A control sample (with no *Moringa Oleifera* treatment) was also included. Physical and chemical properties of abattoir wastewater were investigated before and after treatment. The turbidity value was reduced drastically after the treatments from 15.40 to 7.63 mg/l for 16g dosage in week 7. Total alkalinity, Total hardness, Conductivity, Calcium and Biological Oxygen Demand were all found to be reduced in concentration within the second and fourth weeks of the experiment with 14 to 16g of *Moringa Oleifera* dosage. The results generally showed that 16g/500ml of *Moringa Oleifera* was able to treat abattoir wastewater after weeks of experiment.

KEYWORDS

Moringa Oleifera, wastewater, abattoir, dissolved oxygen, biological oxygen demand

POSTER PRESENTATION

53. CAFEi2023: 125-110

CONCEPTUAL DESIGN IMPROVEMENT AND ASSESSMENT OF AN OIL PALM HARVESTING MACHINE VIA COMPUTER-AIDED DESIGN SOFTWARE.

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ABSTRACT

This paper proposes a new conceptual design improvement to increase the machine's efficiency. Three design improvements, - changing the track system to tyres, integrating a six-axis robotic arm and separating the cart system - were proposed, constructed and analysed using appropriate and available tools. When the track system changed to tyres, the travelling speed increased to 3.5 times that of the current speed, i.e., 13 km/h. The cart was separated into an additional chassis so the centre of mass could be maintained at the proper position. The six-axis robotic arm added flexibility for the harvesting tool. Economic analysis indicated that the new machine design had a lower operational expenditure (OPEX), i.e. (RM58.94 compared to RM60.78), although the price of the new machine was RM100,000 higher. It can be concluded that the new design improvements using CAD software could be used to assess the machine's viability without constructing a physical prototype.

KEYWORDS

Oil palm, agriculture, harvesting, design, CAD

54. CAFEi2023: 004-023

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING STINGLESS BEE HONEY

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ABSTRACT
Zinc oxide nanoparticles (ZnO Nps) has been known for its unique characteristics such as antimicrobial and antioxidant. Generally, ZnO Nps also has been recognize as safe by the US Food and Drug Administration for its application in food industries. Various methods have been carried out by researchers to produce ZnO Nps chemically and biologically as green methods, yet information of synthesis ZnO Nps using stingless bee honey (SBH) are scarce. Additionally, SBH has also been reported having antimicrobial and antioxidant properties. Thus, this study emphasizes on usage of SBH in synthesizing ZnO Nps as a green method. Characterization of ZnO Nps synthesized using SBH have been carried out and results shown are promising which were confirmed by FESEM, FTIR, and XRD analysis. The synthesized ZnO Nps characteristics were <100 nm for particle size, reveals absorption wavelength of zinc oxide and honey, and crystalline structure.

KEYWORDS
Zinc oxide, nanoparticles, stingless bee honey, green synthesis.

55. CAFEi2023: 019-024

LIFE CYCLE ASSESSMENT (LCA) OF GREENHOUSE GAS EMISSION FROM FERTILIZER APPLICATION IN RICE PRODUCTION IN MALAYSIA

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ABSTRACT

Rice paddy cultivation is one of the leading source of greenhouse gas (GHG) emissions and other environmental problems. Thus, the aim of this research is to assess the quantity of greenhouse gas emissions from fertilizer application in rice paddy production in Malaysia using Life Cycle Assessment (LCA) technique. The study involved of four steps; (1) goal and scope definition, (2) life cycle inventory analysis (LCI), (3) life cycle impact assessment (LCIA) by using OpenLCA software, and (4) result interpretation. The data were collected from literature review and input into the OpenLCA software. The results showed that the largest value of kg CO_2 eq emission in Malaysia's rice paddy comes from the use of urea with a value of 310.kg CO_2 eq. emission. The second highest CO_2 eq emission comes from the manufacturing of ammonium nitrate phosphate, a form of nitrogen fertilizer with a value of 104.0 kg CO2. Results showed that the highest contributor of CO2 eq emission is from the usage of chemicals in the field like fertilizers, herbicides and pesticide. The findings can be used as a basis policy for developing a strategy to reduce carbon emission, especially in critical industries like agriculture.

KEYWORDS

Life cycle assessment, rice, sustainable agriculture, fertilizer, green house, gas emission

56. CAFEi2023: 082-054

FRACTURE ANALYSIS OF POLYPROPYLENE NANO CLAY BAMBOO FIBRE

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ABSTRACT

This paper presents the findings of fracture toughness of polypropylene nano clay bamboo fibre composite which is presented in three distinct sample that consist of 0 wt.%, 3 wt.% and 6 wt.% of bamboo fibre. Bamboo is abundant in most tropical regions, but it has not been used to its full potential as a reinforcing agent. Therefore, this study will analyse the fracture of polypropylene nano clay bamboo fibre to prove potential of natural fibres to improve properties of polymer. The composite sample was moulded by an injection moulding procedure containing polypropylene (PP), bamboo fibre, polypropylene-graft-maleic anhydride (PPgMa), and nano clay. The optimal injection moulding temperature for the sample was determined using differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The Mode1 plane strain fracture toughness of Polypropylene-nano clay-bamboo fibre was evaluated using the Linear Elastic Fracture Mechanics (LEFM) approach in accordance with ASTM D5045. As for the results the composite with 6 weight percent bamboo fibre has the highest value of the average fracture toughness with 62.9743 MPa.$m^{1/2}$ than sample with 3 weight percent bamboo fibre which is 59.6709 MPa.$m^{1/2}$ while the sample without the presence of bamboo fibre has lower average fracture toughness at 43.260 MPa.$m^{1/2}$. In conclusion the bamboo fibre has proven its potential to be reinforcing agent as the sample with the presence of bamboo fibre has greater fracture toughness compared to sample without the presence of bamboo fibre.

KEYWORDS

Fracture toughness, three-point bending test, bamboo fibre, polypropylene, nano clay

57. CAFEi2023: 089-079

PREPARATION OF ESSENTIAL OIL NANOEMULSIONS AND ITS INCORPORATION IN CHITOSAN–BASED EDIBLE COATING ON GUAVA

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ABSTRACT

Nanoemulsions possess powerful nano-scale properties that make them attractive for diverse applications. In this work, two types of essential oil namely clove essential oil (CEO) and lemon essential oil (LEO) were formulated into nanoemulsions using high pressure homogeniser (HPH). The essential oils were mixed with virgin coconut oil (VCO) at different formulation to stabilize the oil from coalition effect. The characterization of nanoemulsions produced was done by observing the appearance of the nanoemulsions and analysing the droplets size and the stability of the nanoemulsions during one-month storage at 25˚C. The formulations with the smallest droplet size and was stable during the storage period were then incorporated with chitosan to produce edible coating on guava. Five samples of guava were coated with chitosan only (CH), chitosan containing clove nanoemulsion (CH-CEO (HPH)), chitosan containing clove oil coarse emulsion (CH-CEO), chitosan containing lemon nanoemulsion (CH-LEO (HPH)) and coated with chitosan containing lemon oil coarse emulsion (CH-LEO). The microbiological analysis of all samples were determined by total plate count and yeast and mould counts. The weight loss, firmness, colour and pH of coated guava during storage at 25°C for 10 days were also determined. The results obtained shows that CH-CEO (HPH) and CH-LEO (HPH) are significantly ($p<0.05$) effective to reduce the total plate counts and yeast and mould counts to prolong the shelf life of guava. The nanoemulsion coatings also slowed down the weight loss, the increase in yellowness, and the decline of lightness and greenness of guava during the storage period, hence preserving the guava better compared to those coated with chitosan only and chitosan with coarse essential oil emulsions.

KEYWORDS

Edible coating, essential oil, nanoemulsion

58. CAFEi2023: 090-066

LINEAR REGRESSION AND MACHINE LEARNING MODELING FOR CHLOROPHYLL CONTENT ESTIMATION USING LEAF RGB IMAGES

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ABSTRACT
Researchers frequently analyse plant data to enhance crop production and crop quality. The plant chlorophyll content is one of the main indicators of crop quality status. The conventional methods and procedures to determine plant chlorophyll content are laborious, time-consuming and costly. However, with machine learning adaptation, plant data can be analysed more proficiently using RGB images obtained from a smartphone camera. Therefore, this study aims to utilise machine-learning algorithms to predict lettuce's chlorophyll content based on RGB leaves images. Machine learning algorithms were run using RapidMiner Tool software on indices of 60 images. The actual leaves' chlorophyll content was measured using a SPAD chlorophyll meter. The correlation of GDR indices with the leaves' chlorophyll content using linear regression was around 79.91%, with the lowest Root Mean Square Error (RMSE) of 6.62 g of chlorophyll/100 g fresh tissue. The utilisation of machine learning algorithms with Principal Component Analysis (PCA) increased estimation accuracy by up to around 24%. The highest accuracy was achieved using the Support Vector Machine (SVM) algorithm with selected highly correlated image indices, resulting in the lowest RMSE of 5.07 g of chlorophyll/100 g of fresh tissue.

KEYWORDS
Machine learning; RapidMiner tool; leaves images, RGB indices, chlorophyll content

59. CAFEi2023: 041-136

XYLITOL PRODUCTION VIA FERMENTATION BY *CANDIDA TROPICALIS* WITH THE EFFECT OF TEMPERATURE AND PH

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ABSTRACT
Xylitol is a sweetener substitute that is used in the food, odontological, and pharmaceutical industries. In this study, the fermentation of xylitol production was performed at varying temperatures (25 to 40 °C) and pH levels (3, 5, 6.5) in stirred tank bioreactor. Kinetic models were proposed for the batch production of xylitol from xylose by *Candida tropicalis* and to describe the effect of temperature and pH on the kinetic parameters of xylitol fermentation. The experimental data from a series of batch fermentation with different environmental parameters were used to evaluate unknown parameters via gPROMS software. Seven kinetic parameters ($\mu_{max,S}$, $k_{\mu 1}$, $k_{\mu 2}$, T_{opt}, nT, E_C, and σ) included in the model based on the temperature and pH of the cell growth rate were subsequently established. For validation of the model, experiments were performed in a 50 L bioreactor. The optimum xylitol and cell yield were estimated as 0.71 g xylitol/ g xylose and 0.26 g cell/g xylose, respectively at 32 °C and pH 5. The simulation profiles of cell growth, xylose degradation, and xylitol production exhibited the best fit with 95% significance, and an optimal solution was obtained via gPROMS software.

KEYWORDS
Candida tropicalis, fermentation, kinetic model, xylitol, xylose

60. CAFEi2023: 105-089

THE INFLUENCE OF MICROWAVE DRYING ON DRYING AND REHYDRATION KINETICS OF *ACANTHUS ILICIFOLIUS* LEAVES IN TEA PRODUCTION

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ABSTRACT

Acanthus ilicifolius, commonly known as Jeruju, is a medicinal herb found in Malaysia, recognized for its anti-inflammatory and antioxidant properties, making it an ideal candidate for healthy tea. This study investigates the crucial drying and rehydration processes of Acanthus *ilicifolius* leaves in tea production, focusing on kinetics and characteristics. Utilizing microwave drying with varying power levels, four mathematical models; Page, logarithmic, Newton, and Midili & Kucuk were employed to analyze drying behavior, while Peleg and first-order kinetic models were applied to the dried leaves in powder form for rehydration behavior assessment. Results demonstrate microwave drying at 1000 W as the fastest, taking only 20 minutes, while commercial shade drying requires 72 hours. The Page model best fits the drying behavior, showing higher RMSE values (0.9840-0.9999) and lower X^2 values (0.0007-0.0048) for both methods. Microwave drying process preservation yields the lowest a* value of $-4.16^{BC}\pm0.61$, and microwave drying post-commercial drying exhibits DPPH inhibition value of 23.84%. The study emphasizes the significant impact of drying method on *Acanthus ilicifolius* leaves, offering valuable insights for optimizing tea production with this medicinal herb.

KEYWORDS

Acanthus ilicifolius, herbal tea, drying, microwave drying, shade drying, rehydration

61. CAFEi2023: 086-057

BIOACTIVITY AND CHEMICAL PROPERTIES OF WATERMELON CULTURED DRINK USING PROBIOTIC STRAIN OF LACTOBACILLI

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ABSTRACT

Watermelon (*Citrullus lanatus*) is a fruit with a watery red pulp, sweet taste and contain scattered black seeds throughout the flesh. Watermelon consists of water (91 %), sugar (6 %) and other nutrients such as vitamin C, carotenoids and lycopene. The nutrient content of watermelon could favour the growth of *Lactobacillus sp*., thus has potential to be introduced as watermelon cultured drink. The objectives were to identify the viable growth of *Lactobacillus sp*. starter cultures and to determine the chemical properties of the product. The cultured watermelon drink was prepared by inoculating the starter cultures into a conical flask containing the mixture of milk solution and puree of watermelon. The mixture was put on a shaker and incubated at room temperature overnight. The produce was then pack into sterilised bottle and store in a cool room. Analyses were done every week for 4 weeks of storage. Results had showed a correlation between pH and acidity content which indicated at low pH caused high acidity in the watermelon cultured samples with sample P was sourer compared to sample B. The total soluble solid content was gradually high until the third week then slightly decreased at the fourth week. The lycopene content also increased gradually from the first week until the fourth week with the highest content was found in sample M. All *Lactobacillus sp.* starter cultures were able to grow in each sample of watermelon cultured milk. Amongst all, the *Lactobacillus sp.* in sample M was found increased gradually in the watermelon cultured milk. In comparison, study on *Lactobacillus sp.* grown in the cultured milk had showed a similar growth profiles, however the control only survived for a week. Therefore, the bioactivity of *Lactobacillus sp.* in watermelon cultured drinks is a promising and new innovation of functional products that can provide beneficial nutrition and viable good bacteria for the health wellness.

KEYWORDS

Watermelon, *Lactobacillus sp.*, cultured drink, viability and lycopene

62. CAFEi2023: 006-027

GREEN SYNTHESIS OF SILVER AND ZINC OXIDE NANOPARTICLES USING STINGLESS BEE HONEY

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ABSTRACT
Green synthesis of nanoparticles (NPs) has emerged as an eco-friendly alternative to produce nanomaterials with diverse physical, chemical, and biological characteristics. Green synthesis of NPs using natural molecules from bacteria, fungi, and especially plants have come forward as a potential alternative for the synthesis of a diverse range of NPs. Stingless bee honey (SBH), which also well-known as 'superfood' is a relatively new concept for the synthesis of metal and metal oxide NPs. In the synthesis of NPs, SBH acts as both a stabilizer and a reducing agent and functions mainly as a precursor. Considering the potential use of SBH in NPs synthesis, in this study we use this kind of honey for the synthesis of silver (Ag-NPs) and zinc oxide NPs (ZnO-NPs) and their physicochemical characteristic were evaluated by UV-Vis, TEM, and FTIR.

KEYWORDS
Green synthesis, stingless bee honey, silver nanoparticles, zinc oxide nanoparticles

63. CAFEi2023: 039-073

THE TEXTURAL MODIFICATION FOR 3D PRINTED MEAT AND SEAFOOD: A MINI REVIEW

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ABSTRACT
Three-dimensional (3D) printing technology has been lauded for its unrivaled capacity to make food items with sophisticated architecture, sustainable material and energy costs. 3D printed meat and seafood development has gained attention as a potential solution for addressing sustainability and food security issues in the food industry. A mini–review was undertaken to offer the most recent developments in enhancing the textural qualities of meat substitutes to fulfil customer demands. The review examined techniques to improve the meat–like sensory qualities of plant–based and hybrid meat analogs. Furthermore, the mini review suggested understanding the challenges and future work corresponding to 3D printed meat and seafood. Further research was required to comprehend this technology's potential benefits and limitations fully.

KEYWORDS
3D printing, 3D food printing, hybrid meat, meat analog.

64. CAFEi2023: 115-099

QUALITY AND SHELF-LIFE PERFORMANCE OF STARFRUIT CV. BINTANG MAS AT DIFFERENT MATURITY INDEXES USING SPIRULINA AND CHITOSAN EDIBLE COATINGS

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ABSTRACT
The purpose of this study is to evaluate the quality and shelf-life of starfruit cv. Bintang Mas at different maturity indexes treated with spirulina and chitosan edible coatings. The physical appearance, colours, fresh weight loss, texture, pH, total soluble solid (TSS) and total phenolic content (TPC) determined throughout 9 weeks of storage at 5°C. Physical appearance of Bintang Mas showed no changes at week 1 to week 8, however, brown lesions started to visible at week 9 especially at index 6. Lesions on control samples were more visible compared to coated samples at week 9. Index 2 obtained the highest increment in the lightness but decrement in the hue value compared to index 4 and 6 which demonstrate significant ($p < 0.05$) colour changes from green to yellow. This colour changes effected the chroma reading for index 2 with increasing trend while constant values obtained by index 4 and 6. Coated samples resulted to low chroma reading in comparison with control at all indexes. It was also found that the lowest weight loss and highest texture were demonstrated by Bintang Mas at index 2 where spirulina performed better as moisture barrier properties compared to chitosan and control sample. TSS was higher at index 4 and 6 but TPC was not significant between indexes. Bintang Mas treated with spirulina has the highest TPC content followed by chitosan and control. Correlation analysis and optimization were performed and spirulina coatings was chosen as the best coating with R^2 value near to one.

KEYWORDS
Coating, chitosan, spirulina, starfruit, quality, shelf life

65. CAFEi2023: 142-122

SUGAR EXTRACTION FROM BAMBOO SHOOT VIA ENZYMATIC HYDROLYSIS

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ABSTRACT

This study investigated the potential of *Dendrocalamus asper* or often referred as Buluh Betung for ethanol production. This biomass was utilised as feedstock to produce fermented sugars by breaking down the complex sugar into simple sugars. Prior to enzymatic hydrolysis, the biomass was pre-treated with dilute sulfuric acid subjected to a range of pH (3, 4, 5), enzyme concentrations (840, 1020, 1200 U/g substrate) and temperatures (40, 50, 60˚C). High-performance liquid chromatography (HPLC) were used to analyse the sugar content. The result revealed that the greatest glucose production occurred at a pH was 4, enzyme concentration of 1020 U/g and temperature of 50˚C, with sugar yield of 17.8 mg/g. The other sugars include fructose, xylose, sucrose, galactose, mannose and fructose were also in the samples. This finding suggests that bamboo shoots have the potential to serve as a fuel source for bioethanol production.

KEYWORDS

Dendrocalamus asper, enzymatic hydrolysis, sugars, ethanol production

66. CAFEi2023: 024-015

ELUCIDATING ULTRASONIC AND OZONE TREATMENT FOR PURPLE SWEET POTATO STARCH MODIFICATION

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ABSTRACT

Oxidized starch, a valuable starch derivative, offers versatile applications in the food industry. However, traditional chemical oxidation methods suffer from limited yields and environmentally challenging wastewater disposal. To address these issues, this study proposes a novel approach: starch oxidation through the synergistic combination of ultrasonic and ozone treatment. Ozone exhibits exceptional potential for thermodynamic oxidation, facilitating low-temperature reactions. Simultaneously, ultrasonic treatment disrupts the crystalline structure of starch granules, providing an ideal platform for the development of oxidized sweet potato starch. In this study, sweet potato (var. Anggun) was selected as a representative starch due to its comparable functionalities with other starch types. Physicochemical characteristics, including solubility, swelling, and thermal properties, were comprehensively evaluated for the resulting oxidized sweet potato starch. The findings revealed significant enhancements in the sonicated-oxidized starch properties. The sonicated-oxidized starch exhibited high amylose and carboxyl content, low viscosity, high solubility and swelling power, and improved thermal stability with relatively modest enthalpy of gelatinization ($p < 0.05$). These results indicate the considerable potential of the obtained oxidized starch as an emulsifier, gum arabic replacer, and binding agent in the food industry. By leveraging ultrasonic and ozone treatment, our study successfully demonstrates an innovative and sustainable method for starch oxidation, offering improved yields and minimizing wastewater-related challenges. This research opens new avenues for starch modification, facilitating the development of functional starch derivatives with enhanced performance and broader industrial relevance.

KEYWORDS

Starch modification, ultrasonic, ozone, sweet potato starch, physicochemical

67. CAFEi2023: 001-055

VALORIZATION OF SPENT COFFEE GROUND (SCG) FOR SCENTED CANDLE PRODUCTION

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ABSTRACT

Approximately 6 million tonnes of waste coffee grounds (SCG) are produced annually but only 25% were reused and the rest ended up going to landfills. One if the potential of SCG is to be used as scented candle. This is due to low moisture and ash content, and high oil fraction of SCG. This research aimed to investigate the physico-chemical properties of different types of SCG and the suitability of the SCG to be used in scented candle making. SCG from different brewing methods such as moka pot and espresso were used in this study. The physicochemical properties of these SCGs were analysed. In candle making, different concentrations of SCG were applied, ranging from 20 – 50%. From the results, it could be seen that physicochemical properties of moka pot and espresso brewed SCG were different hence could effect the performance of the scented candle produced using the SCG. The burning performance such as wax consumption rate, pool size and flame height were measured. In conclusion, the suitable concentration of SCG that can be used as the scented candle was found for 30% and 40% of Moka pot with the addition of soy wax, 20% espresso concentration, and 30% Moka pot with the addition of paraffin wax.

KEYWORDS

Valorization, spent coffee grounds, scented candles

68. CAFEi2023: 012-064

FROM TRADITION TO CONVENIENCE: USING SAUSAGE TECHNOLOGY TO BRING MALAYSIAN BANANA-BASED DESSERTS TO THE MASSES

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ABSTRACT

Bananas are a popular fruit worldwide and are commonly used in Malaysian traditional desserts such as *pengat*, *cekodok*, *lempeng*, *apam*, *lepat*, and *bingka*. These delicious banana-based desserts have great potential to be introduced to the global market by increasing their commercial value. One way to achieve this is by transforming the desserts into a ready-to-eat food for consumers' convenience and preference. Thus, this study aimed to develop a banana-based traditional dessert using sausage technology that could be easily consumed. The product development involved formulating the dessert based on the bingka pisang recipe, using overripe bananas for the suitability of the process. The results showed that a higher amount of banana in the formulation resulted in a softer texture, higher moisture content, and a darker color. Sensory evaluation indicated that the sample with a higher amount of banana in the formulation was more acceptable compared to other samples. Based on the findings, converting banana-based traditional desserts into ready-to-eat food using sausage technology appears promising. However, further exploration is required to improve the product for customer acceptance and commercialization purposes. In this regard, we propose a process design, particularly for small-scale industries, for the production of 67.53 kg/HR RTE banana dessert from 62.05 kg/hour of fresh banana.

KEYWORDS

Banana, traditional dessert, sausage technology, product development, process design.

69. CAFEi2023: 053-102

EFFECT OF DIFFERENT STORAGE TEMPERATURES ON THE PHYSICOCHEMICAL, PHENOLIC CONTENT AND MICROBIOLOGICAL QUALITIES OF THE RECONSTITUTED POMEGRANATE JUICE (RPJ) AFTER THERMAL AND ASEPTIC PROCESSING

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ABSTRACT

This study investigated the effects of ambient (25±2°C) and chilled (4±1°C) storage on the quality of reconstituted pomegranate juice (RPJ) after thermal pasteurization at 95˚C for 30 s and aseptic bottling. The quality parameters analyzed included pH, total soluble solids (TSS), color, total phenolic contents (TPC), and microbiological inactivation. The analysis was conducted at intervals of 7 days over a period of 49 storage days. Results showed that while both storage temperatures resulted in satisfactory microbial inactivation, the ambient sample exhibited greater fluctuations in pH (ranging from 2.90 to 3.07) compared to the chilled sample (stable range of 3.04 to 3.12). The color difference was more evident in the ambient, due to the significant changes in CIE *L* and CIE *b* caused by browning, which was accelerated at warmer temperatures. The ambient sample also exhibited a greater TSS variation (23.5 to 26.9) compared to the chilled sample (23.9 to 26.5), suggesting ongoing chemical reactions affecting sugar content. While TPC values remained stable at 4°C throughout storage (no significant difference, p=0.082), the ambient sample showed significant changes in TPC (p=0.00). Interestingly, TPC levels remained high (>2000 mg GAE/L) for both ambient (2207.06 to 3909.89 mg GAE/L) and chilled samples (2491.81 to 3148.59 mg GAE/L) throughout the storage period. In conclusion, the study recommended chilled storage to maintain juice quality and the functional properties souring from phenolic contents. However, if ambient storage is chosen, implementing a faster time-to-consumer strategy is crucial to minimize quality degradation and ensure market acceptability.

KEYWORDS

Pomegranate juice, storage temperature, quality, phenols, properties

70. CAFEi2023: 139-119

SEMI-FINISHED MEAT PRODUCT FORTIFIED BY LENTIL FLOUR

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ABSTRACT

The meat industry has various types of the secondary raw materials with high nutritional values. Mostly, as the secondary raw materials following by-products are used: tongues, kidneys, heart, meat tripe of beef carcasses and others. Using plant origin additives in the fortification of recipes and technologies allows for the creation of new functional food products. As vegetable raw materials, domestic plant crops such as Lentil have significant value. Lentil (*Lens culinaris*) is a nutritious and popular food raw material all over the world. The protein content in lentil varies depending on the variety and the place of reproduction from 27 to 36%. Lentil contains a large amount of calcium, phosphorus, magnesium, copper, also vitamins B_3, B_1, B_6, B_5, B_2. Addition of lentil to foods can to enhance a nutritional value of the semi-finished meat products. In the presented work, a possibility of the creation recipe and technology for the cutlets by adding of lentil flour is investigated. The study aim is the development of new semi-finished meat product - cutlet technology fortified by lentil flour with enhanced nutritional and organoleptic properties, as well as the research of the mineral elements content. The introduction of lentil in the chopped semi - finished (cutlets) meat product, allows for the expanding a range of new meat products. The mineral elements composition was identified using the Raster Electron Microscope and inductively coupled plasma mass spectrometry. The studied samples have nutritional values and essential vital necessities mineral components: sodium, magnesium, phosphorus, potassium, calcium others. The offered semi-finished meat product fortified by lentil flour can be consumed as functional food product for a healthy nutrition.

KEYWORDS

Cutlets, functional food, Lentil, meat, semi-finished product

71. CAFEi2023: 144-124

FUNCTIONAL CORN - BASED PRODUCT

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ABSTRACT
The article presents recipes for canned vegetables based on corn, in order to create a new assortment for functional nutrition, "Fruit and vegetable purees" contain macro- and microelements such as: sodium, magnesium, phosphorus, sulfur, chlorine, potassium, calcium and others. The content of the elemental composition was determined by inductively coupled plasma mass spectrometry (ICP-MS) and using a Scanning Electron Microscope (SEM). Corn groats were used as the main component, pumpkin, carrot, pear were an additional component. The samples were subjected to sensory analysis of the assessment of the intensity of characteristics by assigning a rating using a point scale. The formulation of Sample 1 showed a good result and the average score was 4.4. Considering the organoleptic evaluation results, profiles were built for each of the five characteristics: taste, color, flavor, appearance and consistency, as well as a diagram of the general sensory estimate of new canned samples.

KEYWORDS
Corn, canned vegetables, functional products, recipe, nutritional value.

72. CAFEi2023: 079-052

THE EFFECT OF ADDING *GARCINIA ATROVIRIDIS* ON pH, COLOUR AND ANTIOXIDANT PROPERTIES OF ROSELLE TISANE

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ABSTRACT

Roselle (*Hibuscus sabdariffa*) is rich in antioxidant and phenolic compounds especially anthocyanins which have shown therapeutic potential. The anthocyanins content increases in an acidic solution hence enhancing the antioxidant properties and colour intensity. This study was carried out to investigate the influence of adding *Garcinia atroviridis* on the pH, colour, anthocyanin content and antioxidant properties of roselle tisane since *Garcinia atroviridis* infused water has a sour taste because of its low pH. The ratio of roselle: *Garcinia atroviridis* (GA) (w/w) studied were 2:1, 2:2 and 2:3. The results showed that the pH was decreased as the amount of GA increased, hence increasing 25% of the anthocyanins content of roselle tisane. Furthermore, the colour of the tisane with GA became bolder and more saturated, as indicated by the increase in colour values (L*, a*, b*, chroma, and hue angle) with higher levels of GA. Results of antioxidant properties (total polyphenol, total flavonoid and ferric reducing antioxidant power assay) also showed an increment as the amount of GA increased. Conversely, the DPPH assay demonstrated a 17% decrease in percent inhibition as the amount of GA increased. Roselle tisane infused with GA displayed weakened radical scavenging abilities, as indicated by higher IC_{50} values. However, all samples exhibited effective antioxidant activity, with IC_{50} values below 1 mg/mL. In conclusion, the addition of *Garcinia atroviridis* in the formulation could affect the properties of roselle tisane.

KEYWORDS

Roselle, *Garcinia atroviridis*, tisane, anthocyanins, antioxidant

73. CAFEi2023: 093-090

MICROWAVE HEAT TREATMENT OF GLUTINOUS RICE EMPING

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ABSTRACT

This study is to determine the new cooking method of emping by using a microwave oven at different temperature (230°C, 240°C, 250°C) and time taken (3.30min, 4.00min, 4.30min, 5.00min, 5.30min). Next, to analyze the physicochemical and frictional properties during transformation from glutinous paddy (Siding) at 90 days of maturity to emping. The suitable cooking parameter is at temperature 250^{o}C and time 4.30 minutes. The change in length from glutinous paddy to emping was increased from 10.61mm to 11.01mm. For width, the change from glutinous paddy to emping was found to be 2.51mm to 3.14mm. However, the thickness from glutinous paddy to emping was change from 1.93mm to 1.12mm. Bulk density and true density of emping is lower than glutinous paddy. Lastly, for porosity and angle of repose the value of emping is higher compare with glutinous paddy.

KEYWORDS

Emping, glutinous paddy, microwave oven, temperature, time

74. CAFEi2023: 168-144

PHYSICAL CHARACTERISTICS OF PALM-BASED MOZZARELLA ANALOGUE DURING REFRIGERATED STORAGE

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ABSTRACT

The study was conducted to formulate a palm-based Mozzarella cheese analogue. Palm oil (PO) and palm olein (POo) ratio was evaluated on the fat component of the cheese formulation. The ratios of PO:POo were 100:0, 75:25, 50:50, 25:75, and 0:100. Selection of levels of PO and POo ratios was done to determine the ratio that gives the highest meltability and stretchability values. Palm oil and palm olein with the ratio of 50:50 showed the highest meltability and stretchability values compared to the other ratios and was selected for storage study. The ratio was compared to non-fat cheese and commercial samples. Colour, hardness, meltability, stretchability and sensory evaluation were evaluated. Comparison to the commercial cheese was done on day 1, while the non-cheese fat sample was compared throughout the storage study. The hardness of cheese samples showed an increasing trend during the first 28 days and started to decline until day 56, indicating that the cheese became softer. The meltability of PO50 and the non-fat cheese sample was significantly ($p<0.05$) higher than the commercial cheese sample on day 1. The area of melted PO50 and non-fat cheese samples was more than 100% throughout the storage. The stretchability of PO50 decreased during storage and the stretch length decreased after storage. On the contrary, the stretchability of the non-fat cheese sample increased after storage. Cheese sample PO50 had the maximum score for all attributes in the sensory evaluation of raw cheese and pizza. In conclusion, the palm-based Mozzarella cheese analogue containing palm oil and palm olein (50:50) had superior performance in terms of functionality and was well accepted by panellists.

KEYWORDS

Mozzarella analogue, texture, stretchability, meltability, sensory evaluation

75. CAFEi2023: 167-143

PRODUCTION PERFORMANCE OF LAYING HENS FED WITH GRADED LEVELS OF PALM KERNEL MEAL

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ABSTRACT

The study was designed to assess the production performance of laying hens fed with graded levels of palm kernel meal (PKM). A three-month feeding trial was carried out with 96 Hy-Line Brown laying hens at the Climatic Control House, MPOB Keratong Research Station, Pahang. The laying hens were divided into four treatment groups with four replicates per group and 24 laying hens per treatment. The treatment groups were as follow: T1: 0% PKM, T2: 5% PKM, T3: 10% PKM, and T4: 15% PKM. The number of mortality and egg production were recorded daily, while feed intake and egg weight were recorded biweekly. The feed conversion ratio (FCR) was calculated from feed intake, egg production, and egg weight to determine the feed utilization efficiency in laying hen production. There was only one mortality recorded for T1 and T3 throughout the feeding trial. Laying hens fed T2 showed significantly higher ($p<0.05$) egg production (86.72%) than those of T1 and T3, with 82.40 and 82.62%, respectively. The average feed intake per hen was 110-115 g/day, which is comparable to the standard feed intake for laying hens of 110-120 g/day/hen. Only T4 fed laying hens had significantly higher ($p<0.05$) feed intake than T1. There was no significant difference in FCR between the treatment groups ($p>0.05$), indicating that PKM has promising potential as an alternative local feed material for laying hens. The best FCRs were from T1 and T2 with 2.13, followed by T4 and T3 with 2.18 and 2.22, respectively. In conclusion, PKM can be considered by the feed industry as an alternative feed material for layer feed and can be utilized up to 15% in the diet of laying hens without affecting their performance.

KEYWORDS
Palm kernel meal, laying hens, egg production, feed conversion ratio

76. CAFEi2023: 048-072

NANOENCAPSULATION OF ANTHOCYANIN FOR ACTIVE AND INTELLIGENT BIODEGRADABLE PACKAGING FILMS

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ABSTRACT
The research and innovation for the development of active and intelligent biodegradable packaging films have rapidly increased over the last decade. This is due to the increased demand for creative and innovative food packaging that aims to improve food safety and quality. Recently, the incorporation of anthocyanins in the development of active and intelligent packaging films has received increasing interest due to the wide range of functionalities. Anthocyanin has been widely used as an antioxidant and pH indicator in active and intelligent food packaging. However, the incorporation of anthocyanin in bio-based packaging remains a challenge. Despite the numerous advantages of anthocyanins-based intelligent packaging films, their applications are hindered by the low stability of anthocyanins and susceptibility to oxidative degradation, limiting their application in biodegradable food packaging. Nanoencapsulation is a promising method for improving the stability of anthocyanins, providing protection against degradation, enhancing functionality, improving physicochemical functionalities, and controlling delivery or release. This review presents recent advances in the nanoencapsulation of bioactive compounds and their applications in bio-based food packaging.

KEYWORDS
Anthocyanin, biodegradable, biopolymer, nanoencapsulation, packaging

77. CAFEi2023: 025-074

CHARACTERIZATION OF PH-SENSITIVE SUGAR PALM STARCH FILMS LOADED WITH ANTHOCYANIN FOR SMART FOOD PACKAGING APPLICATION

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ABSTRACT

Smart packaging involves the incorporation of pH-sensitive anthocyanin (CA) into a starch-based film to determine their freshness level. In this study, sugar palm starch (SPS) extracted from the *Arenga Pinnata* plant as the main matrix was incorporated with CA at different contents (0%, 1%, 1.5%, and 2% w/v) to produce starch-based films. The effects of different CA contents on physical, water barrier, mechanical, thermal, stability properties as well as the colour response of films at different pH buffers and raw chicken fillet samples were observed. The surface topography of SPS film containing CA demonstrated no crack but was rougher than the SPS film without CA. The thickness and swelling degree of the film increased with the increasing loadings of CA, and no significant changes were observed for the moisture content. The incorporation of CA into SPS films resulted in a compact structure and thus, reduced the water vapour permeability. The mechanical properties were analyzed in terms of the tensile strength (TS), elongation at break (EaB) and Young's modulus (YM). Thermal degradation was analyzed by using a thermogravimetric analyzer (TGA). Two methods were used to observe the colour response of film on raw chicken fillet samples. For the direct method, no changes in the colour of films were observed, but for the indirect method, it takes only 2 days for the SPS film to change colour from purple to green. The SPS film containing CA has high tendency to migrate in a low-pH food than in neutral and high-pH foods. For colour stability testing, the colour of the SPS film was maintained after 24 hours. It was found that 1.5% CA was the optimum content of anthocyanin for the SPS film due to high EaB value, low water vapour permeability, and appropriate colour intensity.

KEYWORDS

Sugar Palm, starch, anthocyanin, pH indicator, smart packaging

78. CAFEi2023: 050-091

CHARACTERIZATION OF PATCHOULI ESSENTIAL OILS LOADED-CHITOSAN NANOPARTICLES

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ABSTRACT

Patchouli essential oil (PEO) has been shown to possess potent antimicrobial activity against a broad range of microorganisms. However, its use is limited due to its low stability and fast degradation. Chitosan nanoparticles (CSNPs) have been considered a potential carrier for essential oils due to their biocompatibility, biodegradability, and low toxicity. In this study, we aimed to synthesize and characterize patchouli essential oil-loaded chitosan nanoparticles using the ionic gelation method. The nanoparticles were evaluated for their particle size, encapsulation efficiency, chemical interaction, and antimicrobial activity against selected microorganisms. As a result, PEO-CSNPs had a particle size of 332.0±49.05nm, and a polydispersity index (PDI) of 0.262±0.08. The results of the current study indicated that PEO-CSNPs can inhibit the growth of both *E. coli* and *S. aureus*. This study found that chitosan nanoparticles loaded with patchouli essential oil (PEO) were successfully synthesized using the ionic-gelation method and exhibited potent antimicrobial activity against various microorganisms. The promising results suggest that this technique could enhance the efficiency of PEO as an antimicrobial agent in food products and serve as a delivery system for novel applications, such as active packaging.

KEYWORDS

Nanoparticles, patchouli essential oil, nanoencapsulation, chitosan, antimicrobial activity

79. CAFEi2023: 119-096

WATER STIMULI RESPONSIVE SELF-HEALING PROPERTIES OF RED TILAPIA'S FISH SCALE GELATIN- BASED FILM

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ABSTRACT

Gelatin has an impressive potential for producing biodegradable film due to its good film-forming properties. Nevertheless, the gelatin-based film shows relatively poor performance under loading impact due to the deformation properties, which is important for packaging durability during storage and transportation. At present, most studies were only conducted on the physical and mechanical properties of the fish gelatin-based film. Interestingly, our preliminary studies have also found that fish-gelatin based film has the potential to be healed by physical interaction in the presence of moisture. Yet, the potential of this property has not been explored in-depth in the current researches. Self-healing of polymer is a smart material with extended lifetimes with the capability to repair itself upon damage without the need for detection or repair by manual intervention. Therefore, this study was carried to investigate the self-healing properties of gelatin-based film by using water stimuli. The film was scratched with a razor blade, and a light microscope was used to take pictures of the nicks between the edges. Then, drops of water were introduced to the damaged zones of the films to facilitate the occurrence of the healing process. Within 5 minutes, the film can repair scratches that reach the substrate underlying them utilising water stimuli. In the polymer, absorbed water disrupted the intermolecular hydrogen bonds, allowing the polymer chains to move around and begin the self-healing process. These gelatin-based self-healing films show excellent benefits in scratch repair and have potential use in food packaging.

KEYWORDS

Fish scale, gelatin, water stimuli, self-healing

80. CAFEi2023: 042-092

MOISTURE ADSORPTION AND ELONGATION AT BREAK OF PECTIN-PINEAPPLE JUICE FILMS

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ABSTRACT

Pectin-based films have attracted great interest as substitutes for synthetic films in food packaging applications. Pure pectin films have a good barrier to gases but a poor moisture barrier due to their hydrophilic nature. Fruit-pectin-based films have been made by adding fruit juice or puree to modify the water barrier and mechanical properties of pure pectin films. On the other hand, glycerin is a typical ingredient added to pectin films as a plasticizer, which may change the flexibility of the film, decrease brittleness, and increase moisture adsorption. Moisture adsorption of pectin film is critical in determining the film's durability during packing and the best storage conditions. This work was motivated to examine the effect of various glycerin percentages (10 - 50% wt/wt, pectin basis) on moisture adsorption and elongation at break (EAB) of pectin-pineapple juice (PPJ) films while kept at different relative humidity (RH) and a constant temperature of 25 °C. The static gravimetric technique determined the equilibrium moisture content (Me). Different storage relative humidities were yielded using saturated salt solutions having water activity ranging from 0.11 to 0.90. The weight increase of PPJ films was measured for 7 to 14 days until equilibrium was established, defined as a difference of ± 0.0010 g between two consecutive measurements. The moisture adsorption increased as the glycerin percentages in the PPJ films increased. In addition, the glycerin increased the number of active sites on the surface of the films, which favored water adsorption on the surface of the films. The EAB was tested using a texture analyzer at 0.5 mm/sec test speed and 50 mm beginning grip separation, and with the addition of glycerin to PPJ films, the EAB of the films increased. This result indicates that the PPJ films become more flexible when the moisture adsorbed increases.

KEYWORDS

Pectin, glycerin, water activity, equilibrium moisture content, moisture adsorption, elongation at break

81. CAFEi2023: 116-094

DEVELOPMENT OF PECTIN-PINEAPPLE JUICE FILMS INCORPORATED WITH GINGER ESSENTIAL OIL NANOEMULSION

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ABSTRACT

Essential oil-infused edible films are a promising alternative to single-use food packaging materials. This packaging material offers a practical solution to packaging abundant waste like being quickly dissolved along the release of food content in water upon utilization while fully biodegradable and compostable when disposed to the environment. However, the direct inclusion of commercial essential oils (more hydrophobic) into a pectin-based film mixture (more hydrophilic) makes it difficult to form a miscible film-forming solution. Thus, the ginger essential oil was emulsified before being added to the pectin-pineapple juice (PPJ) film matrix. This study aims to develop PPJ films blended with different loadings of ginger essential oil nanoemulsion (GEONe), ranging from 5% to 20%. The PPJ film without GEONe was used as the control film. The effect of incorporating GEONe into PPJ films in terms of physical, mechanical, and colour properties was evaluated. Differential scanning calorimetry (DSC) analysis was also performed to determine the thermal properties of the PPJ-GEONe films. The thickness of the films significantly increased ($p \leq 0.05$) from 91.0 µm to 112.0 µm as the loading of GEONe increased. Conversely, the PPJ films' moisture content (11.57% to 10.33%) was insignificantly affected ($p > 0.05$) by the presence of GEONe. The water solubility of the PPJ film with 20% GEONe (83.16%) was significantly ($p \leq 0.05$) lower than that of the control PPJ film (93.77%). Overall, the addition of GEONe in PPJ-GEONe films had a significant effect ($p \leq 0.05$) on the films' surface CIE colour parameters including lightness (L*), red/green (a*), yellow/blue (b*), total colour difference (ΔE), and yellowness index (YI). The control film (without GEONe) yielded the highest lightness (L^* value = 84.40) and intermediate yellowness (b^*value = -1.08). As GEONe was incorporated into the PPJ films, the lightness decreased while the b* value, yellowness index, and colour differences increased. Furthermore, the tensile strength and Young's modulus values significantly decreased ($p \leq 0.05$) from 15.97 MPa to 9.54 MPa and from 398.92 MPa to 186.91 MPa, respectively, with increasing GEONe loading. This indicates that the GEONe nano-size droplets have plasticizing effects, increasing the elongation at break of the PPJ films from 8.71% to 16.49%. Additionally, the differential scanning calorimetric curves demonstrated that films incorporated with increasing GEONe exhibited a reduction in the melting enthalpy, which improved the PPJ-GEONe films' thermal stability. These findings

revealed the potential of incorporating hydrophobic plant extracts, such as ginger essential oil, into pectin-based films as nanoemulsions with acceptable alteration on the physical properties of the PPJ films and improvement in flexibility and thermal stability.

KEYWORDS
Pectin-based film, ginger essential oil, nanoemulsion, tensile properties, differential scanning calorimetry

82. CAFEi2023: 043-120

PARTICLE SIZE, DENSITY, FLOWABILITY, COLOUR AND SURFACE OIL CONTENT OF DESICCATED COCONUT OBTAINED FROM OVEN, MICROWAVE AND AIR FRYER DRYING PROCESSES

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ABSTRACT

The drying process of the shredded coconut flesh is an important unit operation in the production of desiccated coconut powder. This work examines the important but less studied physical properties of the desiccated coconut; the mean particle size, flowability, surface oil content and also the commonly studied colour in relation with the hot air convection oven, microwave oven and air fryer for the drying process. The operational variables of these drying processes which are the air temperature and microwave power were studied in terms of how they affect these physical properties of the desiccated coconut. It was found that the mean particle size decreased with increasing air temperature or microwave power, with the size ranges between 250μm – 4mm. Bulk density and tapped density values obtained for the desiccated coconut were approximately in the range of 0.18 g/cm^3 – 0,21 g/cm^{3}and 0.22 g/cm^3- 0.26 g/cm^3 thus possessing good to fair flowability characteristics based upon the measured Carr Index values. Redder and less lightness in desiccated coconut colour was obtained from the air fryer drying process. The surface oil content were approximately in the range of 0.0147 g – 0.0255 g per 5 g samples. Overall, the different drying processes and their operational variables that were studied in this work influence the final desiccated coconut physical characteristics.

KEYWORDS

Desiccated coconut, hot air drying, microwave, air fryer, physical properties

83. CAFEi2023: 018-032

MODELLING OF MASS AND MECHANICAL PROPERTIES OF PAPAYA FOR OPTIMAL HANDLING IN SUPPLY CHAIN OPERATION

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ABSTRACT

Postharvest losses caused by mechanical damage can be reduced through a thorough understanding of the fruit's response to both static and dynamic loads. Modelling and experimental methods were used to quantify and predict the response of fruits during postharvest handling and distribution in supply chains. During these operations, fruits are packaged into grades based on size and mass for uniformity and proper handling. This study aimed to develop a mass prediction model based on the physical geometric properties of papaya and determine the mechanical response of the fruit along its longitudinal axis under static loadings. The physical geometric properties of papaya were measured, and a mathematical model was developed to predict the mass of the fruit. The mechanical response of papaya was determined using a compression test. The power model was shown as the suitable model for predicting the mass of the papaya fruit using projected area and the ordinary least square model as the suitable model using multiple variable models. A compression test was used to determine the elastic modulus, failure stress and failure strain. The viscoelastic parameters were determined by fitting the Maxwell model with stress relaxation test data. The analysis of viscoelastic parameters reveals that the mechanical response of papaya fruit differs at the bottom section when compared to the top and middle sections ($P < 0.05$), resulting in the former being less resistant to deformation. The results of the mass models will aid the digitalization of sorting and grading systems while the results of the characterisation of the mechanical response of papaya provide valuable information on the design parameters for postharvest harvest handling equipment.

KEYWORDS

Relaxation moduli, relaxation time, *Carica papaya* L., mass model, failure parameter

84. CAFEi2023: 094-075

WATERMELON POSTHARVEST AND PROCESS ENGINEERING SYSTEM

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ABSTRACT
In this research, watermelon postharvest and process engineering system was designed, developed and assessed its performance. The watermelon postharvest engineering system integrates a mechanized cleaning and a robotic sizing system with a capacity of 100 - 120 fruits/hour; targeted fresh watermelon for export market. The cleaning efficiency was 90 % whereas the sizing efficiency was 100 %. Adding 250 ppm sodium hypochlorite in water during cleaning process can extend the storage life of watermelon up to the 5th week. The application of vacuum suction cup in robotic sizing system did not cause any mechanical injury to the watermelon. On the other hand, the watermelon process engineering system consists of watermelon peeler, extractor and pasteurizer; targeted watermelon puree production for Small and Medium Enterprises (SME). Watermelon peeler, extractor and pasteurizer has a capacity of approximately 1 peeled watermelon/minute, 430 kg watermelon puree/hour, and up to 90 Liter watermelon puree/batch, respectively. The watermelon postharvest and process engineering system developed showed potential to benefit the fresh watermelon exporter, and watermelon puree producer for market expansion.

KEYWORDS
Mechanized cleaning, robotic sizing, peeler, extractor, pasteurizer

85. CAFEi2023: 114-100

THE EFFECT OF DIFFERENT PRE-TREATMENTS AND DRYING METHOD ON THE NUTRITIONAL QUALITIES AND DRYING KINETICY OF PEGAGA (*CENTELLA ASIATICA L.*) LEAVES

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ABSTRACT

Pegaga *(Centella asiatica L.)* is a herbaceous plant that is rich in nutrients and contains dietary antioxidants which are good to human health. However, due to its delicate texture and high-water content, it is prone to damage and has short shelf life. The most common practice for minimizing moisture content and, consequently, activity of water to a safe amount that extends longevity is drying. The current commercial potential of Pegaga, particularly in dried form, has not been adequately investigated. The effect of various pre-treatments and vacuum drying methods on the nutritional quality of Pegaga leaf were examined in this study. The Pegaga leaves was pre-treated with water blanching, steam blanching, vacuum blanching, and microwave blanching. Pegaga leaves were vacuum oven dried for 1 hour 30 minutes (90 minutes) at 60 °C at 0.01 MPa. The total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity of Pegaga leaves were determined before pre-treatment, after pre-treatment or before drying and after the drying process. Using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) test, the antioxidant activities of methanolic extract solution were assessed. Midilli Kucuk model was selected and fitted with the drying data to understand the drying kinetic of Pegaga leaves. The TPC (0.09 mg GAE/g extract) and TFC (2.22 mg QUE/g extract) of Pegaga leaves increased when it is treated with vacuum blanching. Unfortunately, DPPH assay (0.30%) increased when there is no pre-treatment on Pegaga leaves during vacuum oven drying. This proposed study will be beneficial to the local farmers and fresh produce industries in minimizing quality loss of Pegaga leaves during handling and storage.

KEYWORDS

Pegaga, blanching, vacuum drying, drying kinetics, nutritional quality, antioxidant properties

86. CAFEi2023: 038-103

EXPLORING THE RELATIONSHIP BETWEEN SENSORY PROFILES OF COFFEE BREWS AND THEIR BREWING METHODS

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ABSTRACT

The brewing process for coffee is one of the most important steps in the coffee industry since it has a significant impact on the sensory characteristics of the coffee. This research aimed to investigate the flavour of medium roasted Arabica, Robusta, and Liberica coffee beans with different methods of brewing and to develop mathematical model of coffee brews quality using the sensory profiles. Three brewing methods were used in this study; Pour Over Method, French Press Method and AeroPress Method. Therefore, 9 samples of coffee bean were brewed for sensory evaluation. Panelists as sensory evaluators tasted the coffee samples and described the flavour and taste characteristics. The results showed that AeroPress Method produced the best brew quality for every type of coffee bean. Based on the sensory evaluation data, three artificial neural network models were developed according to the types of coffee beans. The artificial neural network models consist of Model 1, Model 2, and Model 3. These models are chosen from AeroPress brewing method because of the highest total acceptance. Modelling was developed using MATLAB 2020 with Neural Network Toolbox. The best model in this study was the Levenberg-Marquardt Algorithm of Model 1 (10 neurons), Model 2 (5 neurons) and Model 3 (7 neurons). These models produced has the highest validation and best performance which could be used for the prediction of coffee's total acceptance towards consumers.

KEYWORDS

Coffee brewing, coffee flavour, sensory profiles, brewing methods, neural network

87. CAFEi2023: 121-145

MICROWAVE SYNTHESIS OF CARBON QUANTUM DOTS (CQDS) DERIVED FROM KESUM (*POLYGONOM MINUS*) LEAVES.

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ABSTRACT

Carbon quantum dots (CQDs) are gaining popularity due to their unique features, including small size, tunable fluorescence, diverse surface chemistries, and the ability to be synthesized from different precursors. Herbal sources, known for their low toxicity, abundant active compounds, and good biocompatibility, have been utilized as carbon sources for CQD synthesis. In this study, Kesum (*Polygonum minus*) leaves were employed to synthesize CQDs using microwave treatment, employing the Central Composite Design (CCD) in conjunction with Response Surface Methodology (RSM). The aim was to investigate the effects of power (200 – 800 W) and process time (2 – 8 min) on the mass yield and total phenolic content of the resulting PM-CQDs, based on various experimental conditions suggested by RSM.The statistical analysis revealed that power had a more significant impact on the conversion rate than process time for both response variables. The optimized variables were determined to be 284.078 W for power and a duration of 6.44 min. Under these conditions, the mass yield reached 30.92%, with a total phenolic content of 0.6493 mg GAE/g. A series of characterization techniques were employed to study the chemical and optical properties of the numerically optimized PM-CQDs.FTIR analysis indicated the presence of functional groups such as carboxyl, hydroxyl, and amide in the PM-CQDs. The optical properties were characterized by two strong absorption peaks observed in the UV-vis spectra at 246 nm and 300 nm, corresponding to the π-π* and n-π* transitions, respectively, confirming the formation of CQDs. The PM-CQDs exhibited a maximum emission at 434 nm in the blue region, with an excitation wavelength of 320 nm.The results suggest that PM-CQDs have potential applications as natural antibacterial and antioxidant agents. Furthermore, they can be utilized in bio-imaging or as fluorescence probes for metal ion detection. This study contributes to the understanding of synthesis routes and the impact of independent variables on the selected responses. Consequently, it confirms the feasibility of using CQDs derived from herbal carbon sources for a wide range of practical applications.

KEYWORDS

Polygonum minus, carbon quantum dots (QCDs), microwave synthesis

88. CAFEi2023: 098-078

EFFECT OF COMPOSITE TECHNOLOGIES ON THE MECHANICAL PROPERTIES AND BIODEGRADABILITY OF AGRICULTURAL POLYMERIC MATERIALS

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ABSTRACT

The demand for biodegradable polymer for agricultural applications such as plastic mulching, controlled release fertilizer, and controlled release pesticide has increased dramatically in recent years due to environmental concerns, the preservation of soil health, and the convenience of residue management following the growing season. In the past ten years, the number of studies on biodegradable polymers has expanded, which corresponds with the increase in demand. Researchers have found the introduction of composite technologies into polymers to promote biodegradability and improve their mechanical properties to be an intriguing topic. Here, a quick overview of biodegradable polymer composites for agricultural applications is presented. It is intended that this study will shed light on the new development of biodegradable polymer composites for boosting the biodegradability of polymers used in the agricultural sector and its effect on the distribution of agricultural inputs to plants.

Keywords
Biodegradable polymer, controlled release system, degradation

89. CAFEi2023: 122-107

APPLICATION OF TERRESTRIAL LIDAR IN SOYBEAN CROP

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ABSTRACT
LiDAR (Light Detection and Ranging) technology offers one of the most accurate, expedient and cost-effective ways to capture information but the applications have not widely used in the field of agriculture and precision farming. Utilization and applications of remote sensing technology using the Terrestrial Laser Scanning (TLS) systems have risen dramatically in recent years. The goals of this study are to understand how TLS LiDAR data is useful in soybean crops characteristics such as surface area and volume under surface area as well as to study the relationship between the data obtained by the TLS sensor. The test area of this study is located in USDA-ARS, Southern Plains Agricultural Research Center, College Station, Texas. Research plot was divided into 12 subplots based on the fertilizer treatment. From the FUSION point clouds and QTM (Quick Terrain Model) analyses it shows a high correlation between the surface area and volume under surface of the soybean crops consistent with the number of points and density (number of points per square unit) from TLS measurements.

KEYWORDS
TLS, LiDAR, active remote sensing, soybean, point clouds

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WIRELESS WATER LEVEL DETECTION SYSTEM

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ABSTRACT

The irrigation system is crucial in ensuring that each field receives the necessary supply of water to meet the demands of the crops. It is essential to ensure that the water flow is consistent and uninterrupted, and the water levels are monitored and controlled. Therefore, this paper designs wireless water level detection system that works automatically by reading the height of the water level using an ultrasonic sensor. Then, the water level data is sent to an app so that the users can monitor the height of the water in real time. This system was designed using two main components: an HC-SR04 ultrasonic sensor and a NodeMCU microcontroller. The HC-SR04 periodically transmit data of water level in real time, then the NodeMCU upload this to the monitoring platform. Finally, the wireless water level detection system is tested under a laboratory environment. A very strong linear correlation between the measured and actual water level height (R2=0.99) was obtained.

KEYWORDS

IoT, water level sensor, irrigation, HC-SR04 ultrasonic sensor, NodeMCU microcontroller

91. CAFEi2023: 129-142

ASSESSMENT OF NITRATE CONTAMINATION CONTRIBUTION IN SHALLOW GROUNDWATER FOR DAIRY OPERATIONS

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ABSTRACT

Livestock operation activities such as cleaning operation, feeding, milking and manure disposal contribute significantly nitrate loading to shallow groundwater. Polluted groundwater with exceeding permissible levels of nitrate is hazardous and cause adverse health effects. The objective of the present study was to model nitrate contamination in shallow groundwater under dairy operations. The groundwater flow model Visual MODFLOW was adopted to explore nitrate distribution in the shallow groundwater. Electrical Resistivity Tomography (ERT) method was used for characterizing subsurface geological formation at the study site. An overlapping low resistivity with high induced polarization (IP) zone was found below the cow waste channel indicate potential nitrate loading to groundwater. Two monitoring and two existing wells were constructed at the site for groundwater quality monitoring assessment. Upon analysis, the nitrate concentration was compared with the other study at the same location. A comparison revealed a consistent increment of approximately 1.67 mg/L in both groundwater and surface water sampling locations. The concentration of nitrate pollutant found in the current study was used in the simulation as an initial waste state. Results showed that nitrate contamination within the shallow groundwater originates from cow waste channel and sewage pond. The interrelation between groundwater and surface water nitrate contamination were explained through the groundwater movement towards the surface water. The integration of MODFLOW and electrical resistivity tomography offers a powerful tool for evaluating livestock operation activities impacts on aquifer water quality.

KEYWORDS

Groundwater contamination, visual MODFLOW, cattle farm, nitrate, electrical resistivity tomography, chargeability

92. CAFEi2023: 113-097

EVALUATION OF THE CUCUMBER-STARTER (Cu-S) PERFORMANCE IN ACCELERATING FOOD WASTE COMPOSTING

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ABSTRACT

Food waste composting is an effective strategy for reducing food waste and promoting sustainable waste management practices. However, composting can be time-consuming, requiring several weeks to months to complete decomposition. To address this issue, using plant-based microbial inoculants as a composting accelerator has gained attention as a safe and healthy way to manage household food waste. This study aims to evaluate the effectiveness of a novel cucumber microbial inoculant that acts as an accelerator agent in home-scale food waste composting, also known as Cucumber-starter (Cu-S). The temperature, potential of hydrogen (pH), carbon and nitrogen (C:N) ratio, total organic content (TOC), and microbial population are the properties evaluated during the food waste decomposition process. The final compost was examined based on nutrient content, including nitrogen (N), Phosphorus (P) and potassium (K). An evaluation of Cu-S efficiency was carried out by comparing the performance of food waste decomposition when inoculated with Cu-S, Effective Microorganisms (EM) and water as a control compost sample. Findings revealed that the Cu-S and EM compost samples exhibit similar trends in temperature profile, pH changes, C:N ratio decrease and TOC degradation. However, Cu-S outperformed EM in reaching ambient temperature, achieving near-neutral pH, and showing higher TOC degradation. Cu-S also showed higher lactic acid bacteria and yeast populations within 2 days. Moreover, Cu-S compost displayed higher nutrient content, including nitrogen, phosphorus, and potassium. These results show that Cu-S effectively sped up the decomposition process and produced mature compost within 28 days with enhanced nutrient content compared to EM and the control samples.

KEYWORDS

Plant-based microbial inoculant, home food waste, composting, cucumber-starter, nutrient content

93. CAFEi2023: 088-059

INVESTIGATION ON THE TENSILE STRENGTH AND THERMAL PROPERTIES OF THE TRANSPARENT WOOD FOR ULTRAVIOLET RESISTANCE

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ABSTRACT

Transparent wood is a new renewable and sustainable material that has the potential to replace the glass as window material. To reduce the electric consumption of air conditioners of buildings, the high thermal resistance of the material is desired properties for insulating heat from outdoor sunlight and reducing heat loss while the winter season. Transparent wood is made by wood after delignification by chemical method then infiltrate epoxy resin polymer. The objective of this research is to fabricate transparent wood then infiltrated by epoxy resin. Using Universal Testing Machines to measure the tensile strength of transparent wood and Thermal conductivity measurement for measure thermal conductivity of transparent wood. The bending and cracking of transparent wood samples were observed after expose to natural UV light. The density, tensile strength and thermal conductivity measurements of balsa wood, transparent wood, and epoxy resin were measured. The effect of UV exposure has been observed within weeks, the samples become yellow colour and cracked. This change is due to the UV resistance of epoxy resin and chemical substances remained in delignified wood. The tensile strength of transparent wood is 0.02 MPa. The high viscosity of epoxy resin cause infiltration of delignified wood incompletely. It was caused the epoxy resin not to reinforce well the tensile strength of transparent wood. The thermal conductivity of transparent wood is lower than glass. In conclusion, the type of epoxy resin used for fabricating transparent wood should high UV resistance, low viscosity, and long working time. The thermal conductivity of transparent wood is lower than glass.

KEYWORDS

Tensile, thermal, transparent, wood, ultraviolet

94. CAFEi2023: 158-135

THE IMPORTANCE OF AMMONIA REMOVAL PROCESS IN AQUACULTURE SYSTEMS – TOWARDS IMPROVING MALAYSIAN AQUACULTURE PRODUCTION.

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ABSTRACT

Due to natural resources limitation, fish production must be increased in a sustainable way. Rather than adding more areas and water to increase fish production, increased intensity of production per area is a more appropriate method. One of the main priorities and has become continuous challenge during farming operation is to maintain good water quality as this acts as the first defense mechanism to secure fish growth and health in aquaculture systems. Additionally, other inventions related to fish husbandry, feed technology and fish-health-related such as vaccines and probiotics, development will be tested and implemented in the production systems, which further emphasize the importance of water quality in the systems. Water quality determines system carrying capacity which will further determine the maximum production that a system can achieve. Ammonia is one of the most harmful wastes that must be managed in an aquaculture system. Capability of managing ammonia could increase systems' carrying capacity tremendously, especially in super intensive systems. In this article, available methods of ammonia removal will be briefly reviewed. Along with it, suggestion on key water quality parameters to be monitored will be given for each method of ammonia removal. It is hoped that this article will spark the interest of farmers, researchers, and engineers to innovate the current practice of ammonia removal in the aquaculture production system.

KEYWORDS

Ammonia, recirculating aquaculture system, bio-flocs, aquaponics, carrying capacity


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