



Research for Industry

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Connecting academic research to industry

The Journal of the National Science Foundation (JNSF) is the only Sri Lankan journal indexed in the Science Citation Index Expanded (SCIE) having an impact factor of 0.682 as of 2022. The journal publishes scholarly articles of both Sri Lankan and foreign researchers, following a standard peer review process.

Recognizing the potential benefit to the industry this brochure presents selected abstracts of the articles published in March 2023 issue of the Journal.

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Study on compositional changes of king coconut (*Cocos nucifera* var. *aurantiaca*) water and kernel during maturation and evaluation of optimum quality characteristics targeting commercial applications

Agriculture and Food Science

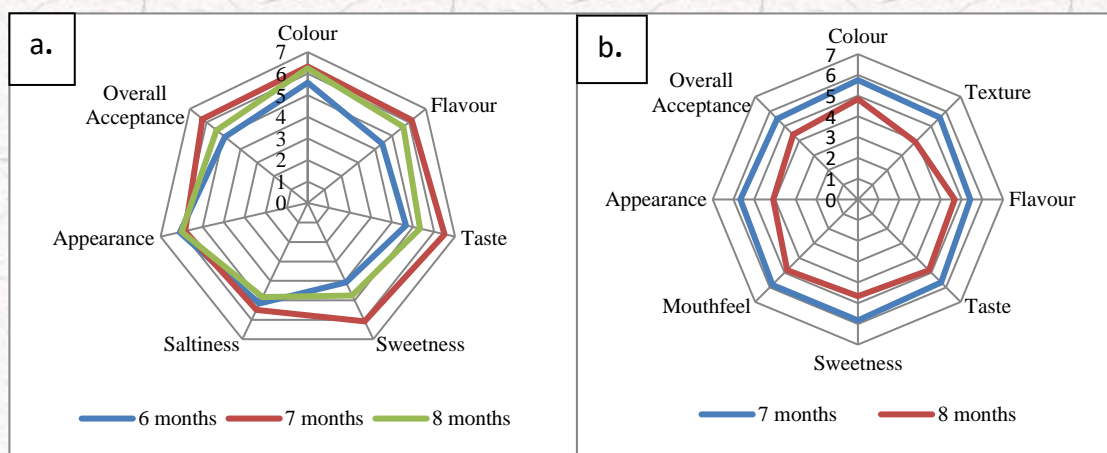
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Abstract

King coconut (*Cocos nucifera* var. *aurantiaca*) is a tropical nut with notable nutritional and medicinal values. King coconut water (KCW) and king coconut kernel (KCK) are sweet and refreshing. They undergo several changes during maturation. The objective of this study was to assess the physico-chemical changes of KCW and KCK with maturity. Three different maturity stages (6, 7, and 8 months) of the variety *aurantiaca*, known locally as 'Nawasi Thembili' were studied for several physico-chemical parameters. Whole nut weight (g), nut-circumference (cm), colour (water/kernel) (*L), nut-water volume (mL), kernel weight (g), and kernel thickness (mm) were assessed as physical parameters, while pH, total soluble solids (*Brix), titratable acidity (as % ascorbic acid), total sugars (g/100g; g/100mL), and minerals (mg/L; mg/kg) were analyzed as chemical attributes. Sugars were estimated using Agilent 1260 HPLC and ICP-MS was used to measure the mineral profile. Results revealed that all the tested physical parameters of KCW and KCK increased significantly ($p < 0.05$) with maturity. The pH, TSS, total sugars, and acidity of KCW increased significantly ($p < 0.05$), while mineral content decreased significantly ($p < 0.05$) with maturity. However, the TSS and minerals of KCK decreased significantly ($p < 0.05$) with maturity and a higher sucrose content was reported in KCK compared to KCW at later maturity. The Ca^{+2} and Mg^{+2} were prominent in both KCW and KCK. The study concluded that the physico-chemical characteristics varied widely with the maturity of king coconuts. The selection of optimum harvest maturity to match the preferred attributes of intended applications is suggested.



Sensory properties at different maturity stages of (a) king coconut water, and (b) king coconut kernel

Link: <https://jnsfsl.sjoi.info/articles/10.4038/jnsfsr.v51i2.11127>

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Prevalence of histamine forming bacteria in selected nodes of the supply chain of Sri Lankan Yellowfin tuna

Food Microbiology

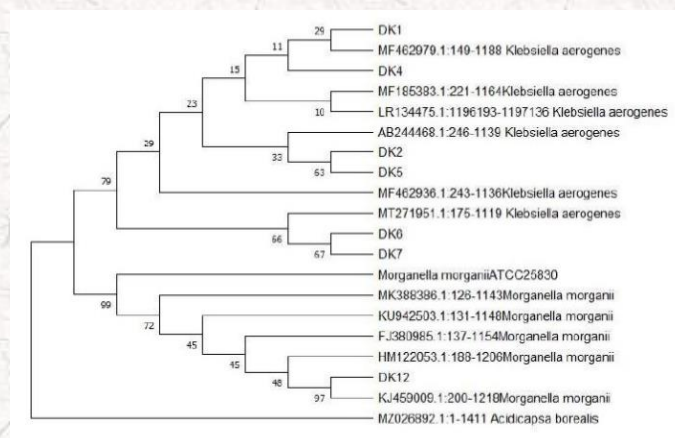
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Abstract

This study aimed to identify histamine-forming bacteria (HFB) and the sources of introduction of such bacteria to recommend control measures to mitigate histamine formation in yellowfin tuna (YFT). Field samples were collected from multi-day boats that landed at Dikkowita, Negombo, Trincomalee and Dondra fishery harbours. Ice from the fish holds (n=63) and chill transport vehicles (n=63), and swabs from the fish holds (n=63), the boat decks (n=63) and the skin of YFT (n=63) were collected. Fish loin samples (n=15), ice samples (n=36) and swabs from the skin of YFT (n=18), floor (n=18) and chill transport vehicles (n=18) were collected from fish processing plants. Presumptive HFB isolated from Nivens medium and Violet Red Bile Glucose (VRBG) agar were screened for histamine forming ability in Trypticase soy broth (TSB) supplemented with 1.0% L-histidine. HFB isolates were characterized by sequencing approximately 1400 bp of the 16S rDNA. Seven isolates that produced histamine in the range of 3000–4000 ppm in TSB isolated from ice samples, and a swab sample collected from the boat deck, were confirmed as *Klebsiella aerogenes* (n=6) and *Morganella morganii* (n=1) respectively. *Hafnia alvei* (n=1), *Serratia* sp. (n=2), *Citrobacter freundii* (n=1), *Rahnella* sp. (n=1) and *Aeromonas salmonicida* (n=8) were also among the isolated histamine forming bacteria. *Pseudomonas* sp. (n=24) and *Shewanella baltica* (n=7), which are known as weak histamine formers and as spoilage bacteria were also isolated. Hence, it is evident that histamine-forming bacteria could be introduced into the fish from ice and contacting surfaces. This necessitates the practice of rigorous cleaning procedures and adaptation of proper postharvest handling procedures to minimize contamination of the fish.



Phylogenetic analysis of the 16S rDNA sequences of major histamine-forming bacteria. Numbers above and below branches indicate bootstrap values from the maximum likelihood method.

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Safety concerns of lead chromate in enamel paints: A study based on the Sri Lankan enamel paints industry after the lead paint regulatory enforcement

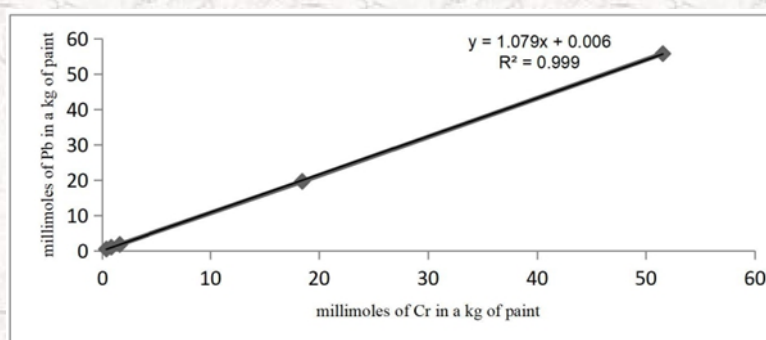
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Abstract

Although lead (Pb) paint testing has been carried out in a large number of studies in Sri Lanka, little work appears to have been done to investigate the chromium (Cr) levels, variation of Pb and Cr levels through different production batches of paint manufacturers and the possible sources of unusually higher Pb and Cr levels in paints. Thirty-six enamel paints manufactured after the lead paint regulatory enforcement, were randomly purchased from six popular brands in Sri Lanka to assess their Pb and Cr levels. Heavy metals in liquid paints were acid digested for the analysis by flame atomic absorption spectrometry (FAAS). From the thirty-six paints analyzed (six colours from six brands) one yellow and one green paint showed highest Pb and Cr levels. Reported Pb levels in yellow and green paints were 11545 ± 6 ppm and 4060 ± 9 ppm and Cr levels were 2681 ± 2 ppm and 960 ± 7 ppm, respectively. These yellow and green paints were labelled as safe although they exceeded the Pb regulatory limit. Pb and Cr in the other 34 samples were below Sri Lankan regulatory limits. For paints with both Pb and Cr, Pb and Cr mole ratio was 1.079:1, suggesting the possible presence of lead chromate (PbCrO_4) in certain paints although the manufactured paints adhered to safety standards. Batch-wise manufacturing variation was also reported. Thus, formulation of national policies and their proper implementation is necessary for manufacturing safe paints in Sri Lanka.



Variation of millimoles of Pb in a kg of paint vs millimoles of Cr in a kg of paint

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Development of vacuum-dried powder and drinking yoghurt from soursop fruit (*Annona muricata* L.) and evaluation of their physicochemical and functional properties

Functional foods

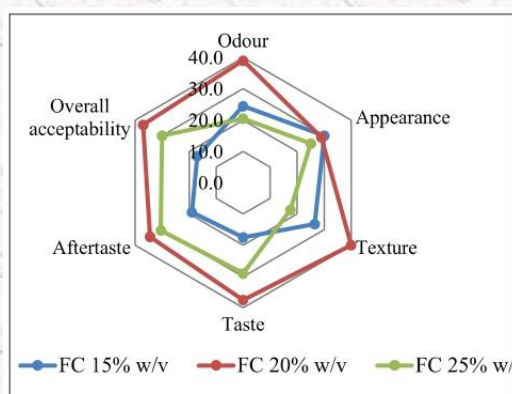
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Abstract

Abstract Soursop (*Annona muricata*) is an underutilized seasonal climacteric fruit which exhibits many therapeutic and nutritive values. The objective of present study was to develop soursop fruit powder and soursop incorporated drinking yoghurt and to evaluate their physico-chemical and antioxidant properties. Soursop fruit powder was developed by inactivating enzymes of matured fresh cuts followed by vacuum drying at 60°C for 6 h. Soursop drinking yoghurt was developed by incorporating soursop pulp (15%, 20% and 25% w/v) followed by selecting the best fruit content (i.e 20% w/v) based on the sensory evaluation trials. Titratable acidity, pH, Total Soluble Solids, Syneresis and Milk Solid Non-Fat of selected soursop drinking yoghurt were 0.85%, 4.5, 16.3 Brix, 29.3% and 13.8%, respectively. The soursop drinking yoghurt (20% w/v) with added sucralose and sugar were separately compared with normal drinking yoghurt as a control. The drinking yoghurt with added sucralose was selected as the most preferable product based on the sensory attributes of odour, appearance, texture, taste, aftertaste, and overall acceptability. A significantly ($p < 0.05$) higher antioxidants potential in terms of total polyphenolic content, total flavonoids content, ferric reducing antioxidant power, radical scavenging activities of 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic) and 2,2-diphenyl-1-picrylhydrazyl were shown in the soursop drinking yoghurt (14.13±0.63 mg GAE/g; 3.39±0.36 mg QE /g; 1.32±0.30 mg TE/g; 30.1±3.24 mg TE/g and 25.67±3.38 mg TE/g, respectively) than vacuum-dried powder. Vacuum dried powder had high content of protein (8.71%), fibre (4.28%) and ash (3.97%). Further study showed the soursop drinking yoghurt as a potential source of functional food while soursop fruit powder as a good supplementary food.



Sensory evaluation of soursop incorporated drinking yoghurts

Link: <https://jnsfsl.sjoi.info/articles/10.4038/jnsfsr.v50i2.10551>

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Bagasse and vinasse, factory wastes from sugarcane industry as potential substrates for bioethanol production

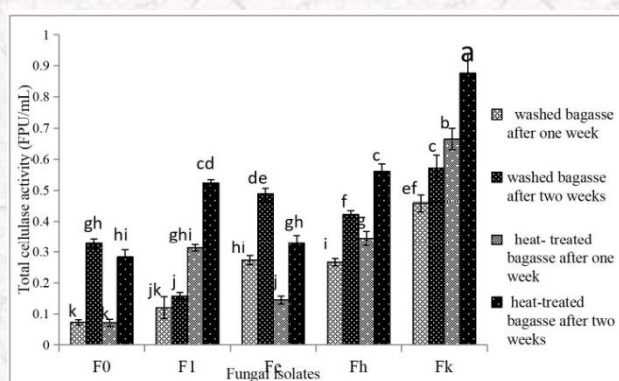
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Abstract

Bagasse and vinasse are by-products of sugarcane-based sugar and ethanol production. While bagasse is burned for electricity generation, vinasse is underutilised. The current study determined whether the combination of bagasse with vinasse as the carbon source could produce bioethanol. Lignocellulolytic enzyme-producing fungi were evaluated for pre-treatment and saccharification of sugarcane bagasse. The vinasse percentage in growth medium which facilitated the maximum growth of yeast and lignocellulolytic fungi was also determined. The most efficient saccharolytic fungi and fermentative yeast were co-cultured in the bagasse + vinasse medium which facilitated their maximum growth. Ethanol was quantified by High-Performance Liquid Chromatography (HPLC) using ethanol standards. *Earliella scabrosa* (M14) was the most efficient isolate in pre-treatment of sugarcane bagasse with 0.764 U/mL of laccase activity. *Aspergillus niger* (Fk) was the most efficient isolate in sugarcane bagasse saccharification. Its prolonged incubation period in non-heated/non-washed, washed and heat-treated bagasse types significantly enhanced the bagasse saccharification potential. Results indicated that combining *E. scabrosa* (M14) with *A. niger* (Fk) could perform simultaneous pre-treatment and saccharification of sugarcane bagasse. A novel finding is that 50 % vinasse + bagasse medium facilitated the maximum growth of lignocellulolytic fungi and fermentative yeast. The highest ethanol yield was given by *A. niger-Candida tropicalis* co-culture (0.005 %) in heat-treated bagasse + Park's mineral salt medium whilst *Trichoderma* sp. (F2)-*C. tropicalis* (Y4) co-culture showed the highest ethanol yield (0.0031 %) in non-heat-treated bagasse + vinasse medium. Therefore, vinasse and bagasse are potential substrates for bioethanol production. Further studies on process optimisation will enhance the final ethanol yields.



Saccharification of heat-treated bagasse and washed bagasse using different fungal isolates. Error bars indicate the standard errors of the means. Values not sharing the same letter are significantly different ($p < 0.05$). X axis indicates the fungal isolates: F0 - *Aspergillus green mold*; F1 - *Trichoderma* sp. ; Fe - *Penicillium* sp.; Fh - *Aspergillus yellow mold*; Fk - *A. niger* sp. Y axis indicates the total cellulase activities (FPU/mL) of respective isolates after one week and two weeks of incubation in respective bagasse medium

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