

# Food and Postharvest Technology



## QUALITY ASSESSMENT OF DEEP FRIED NILE *TILAPIA* (*Oreochromis niloticus*) IN COCONUT AND PALM OIL

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Tilapia is one of the commonly produced inland fish type in Sri Lanka and Nile *tilapia* is the major type in commercial cultivation. Deep frying is popular among Sri Lankan consumers over other processing methods of *tilapia*. However the information on effect of different oils use or deep-frying is not adequate. Thus the present study was conducted to compare the moisture, ash, fat, peroxide value (PV), and free fatty acid (FFA) of Nile Tilapia, deep-fried in coconut and palm oil. The experiment was arranged in Complete Randomized Design with four replicates where raw fish was used as the control. Moisture, ash, fat and FFA were significantly ( $p < 0.05$ ) different in deep fried filets compare to raw fish. Moisture content and crude fat content were significantly ( $p < 0.05$ ) different between the fish fillets fried with both palm (44.08% and 17.25% respectively) and coconut oil (49.05% and 13.51% respectively) as well as in raw fish fillet (80.03% and 1.69% respectively). Ash content of deep fried fish filets using coconut oil (1.581%) and palm oil (1.685%) was significantly higher than that of the raw fish (1.293%). The PV were insignificant between treatments. FFA of deep fried fish fillets using coconut oil (0.812% as oleic) and palm oil (0.833% as oleic) was significantly lower than that of the raw fish (1.403% as oleic). The results highlighted that the absorption of oil during deep frying of Nile *tilapia* is significantly lower in coconut oil than that of the palm oil. However, FFA and PV were not affected by the oil type during deep of Nile *Tilapia*.

**Keywords:** Deep-fat frying, Fish fillets, Nile *tilapia*, Oil uptake, Oxidation

## DEVELOPMENT OF RICE-BASED MILK ALTERNATIVE INCORPORATED WITH *ANNONA* AND *MORINGA*

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Rice-based milk alternative (RMA) is suitable for vegans and people suffering from milk allergy. *Annona* (*Annona muricata*) and *moringa* (*Moringa oleifera*) are rich in nutritional and sensory properties. The objective of this study was to develop and evaluate RMA incorporated with *annona* and *moringa*. Rice-based milk alternative was developed using AT 309 rice variety and different concentrations (v/v) of *annona* (25, 50 and 75%) and *moringa* extracts (5, 10 and 15%) were added separately to develop two RMA. The experiments were conducted in Complete Randomized Design. Developed products were evaluated for colour, odour, taste, appearance, and overall acceptability using nine-point hedonic scale. Then proximate composition of all formulations was analyzed and shelf-life was tested by measuring the pH and microbial count for a period of eight weeks. Sensory data revealed that RMA containing 10% *moringa* and 75% *annona* had the highest overall acceptability. The 10% *moringa* incorporated RMA contained  $10.04 \pm 0.04\%$  protein,  $2.66 \pm 0.05\%$  fat, and  $3.24 \pm 0.06\%$  ash. Its protein content was significantly higher ( $p < 0.05$ ) compared to the RMA containing 5% *moringa*. Moreover the 75% *annona* incorporated RMA contained  $6.06 \pm 0.08\%$  protein,  $0.29 \pm 0.14\%$  fat, and  $1.56 \pm 0.06\%$  ash. Its protein content was significantly higher ( $p < 0.05$ ) compared to the RMA containing 25% *annona*. No significant difference ( $p > 0.05$ ) was observed in pH value among three *moringa* incorporated RMA while pH value of *annona* incorporated RMA was significantly different ( $p < 0.05$ ). Total plate count, yeast and mould were not detected in all RMA packed in aluminum bags during 8 weeks of storage time at room temperature. Therefore, it can be concluded that 10% of *moringa* and 75% of *annona* can be incorporated to develop RMA with desired physico-chemical, sensory and microbiological properties.

**Keywords:** *Annona*, Milk alternative, *Moringa*, Rice

## EFFECT OF INCORPORATION OF *KITHUL* FLOUR ON PHYSICAL, MICROBIOLOGICAL AND SENSORY ATTRIBUTES OF PROBIOTIC SET YOGURT

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The present trend of consumers to choose functional food containing natural ingredients. In this study, set yogurts were developed by incorporating four levels (0.25%, 0.5%, 1% and 1.5% (w/v)) of *Kithul* (*Caryota urens*) flour (KF) in order to evaluate its effect on physicochemical, microbiological and sensory properties of set yogurt. Gelatine incorporated yogurt and yogurt without any added ingredient (control) were used to compare the results. The commercial thermophilic yogurt cultures and *Bifidobacterium bifidum* (BB12) were used for yogurt production. Samples were stored at the 4°C for 21 days and physicochemical and microbiological properties were analysed by weekly intervals. Proximate analysis of both extracted KF and yogurts were evaluated initially. Parametric data were statistically analysed using Statistical Analysis System and mean separation was done by using Tukey's test. Sensory data were analysed using the Friedman test in MINITAB. Addition of all levels of KF result in lower syneresis compared to the gelatine incorporated and the control. The incorporation of 4% (w/v) of KF showed significantly higher ( $p < 0.05$ ) viable count of BB12 in yogurt during the storage, while the control showed the lowest viable count. Sensory data revealed that yogurt containing 0.25% (w/v) of KF led for a higher rank of appearance and odour while yoghurt with 0.5% (w/v) of KF showed the highest rank for taste, texture and overall acceptability. This study concluded that incorporation of KF has a potential to enhance the stability of yogurts and the growth of probiotic bacteria.

**Keywords:** *Bifidobacterium bifidum*, *Kithul* flour, Syneresis, Yogurt



## EFFECT OF PRE-TREATMENT AND COOKING TECHNIQUES ON ANTIOXIDANT CAPACITY AND TOTAL PHENOLIC CONTENT OF COMMONLY CONSUMED LEGUMES IN SRI LANKA

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It is evident that the antioxidants present in legumes can be lost due to pre-treatments and cooking techniques, thus this study was planned to compare the Antioxidant Capacity (AC) and total phenolic content (TPC) of chickpea (*Cicer arietinum*), cowpea (*Vigna unguiculata*) and green gram (*Vigna radiate*) after subjecting to combinations of pre-treatments (soaking and germination) and cooking techniques (cooking using clay pot, cooking using aluminum pot, pressure cooker and microwave oven). AC and TPC were determined using 2, 2-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) assay and Folin-ciocaltue method respectively. Data were analyzed using two factor factorial completely randomized design. The untreated legumes were used as the control. In green gram, soaking followed by microwave cooking resulted the highest TPC ( $267.85 \pm 4.54$  mg GAE/100g DW) among the evaluated treatment combinations which was significantly low compared to control. Microwave cooking of green gram resulted the highest AC ( $2031.48 \pm 400.45$  mol TEAC/100g DW). In chickpea, germination followed by aluminum pot cooking showed the highest TPC ( $266.23 \pm 8.75$  mg GAE/100g DW) and AC ( $1756.7 \pm 244.4$  mol TEAC/100g DW). Both parameters were significantly low compared to the control. Germination of cowpea followed by clay pot cooking resulted the highest TPC ( $282.54 \pm 17.51$  mg GAE/100g), non-significant to the control. Germination followed by aluminum pot cooking resulted the highest AC ( $1403.82 \pm 149.33$  mol TEAC/100g DW), significantly lower than the control. According to the results of the study, germination followed by aluminum pot cooking could be recommended to preserve antioxidants and phenolic compounds in chickpea. Germination followed by aluminum pot cooking of cowpea and microwave cooking of raw green gram could be recommended to preserve antioxidants whereas germination followed by clay pot cooking of cowpea and soaking followed by microwave cooking of green gram could be recommended to preserve phenolic compounds.

**Keywords:** Antioxidants, Cooking, Legumes, Phenolic compounds, Pre-treatment

## EVALUATION OF VARIETY EFFECT OF MUSHROOMS ON VALUE ADDED MUSHROOM PRODUCTS

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Value added mushroom products are a new concept in Sri Lanka. Therefore, a study was conducted to evaluate the effect of different mushroom varieties on value added mushroom products; mushroom fingers and mushroom spread. Mushroom fingers and mushroom spread were prepared in the laboratory using three varieties of mushrooms; Oyster mushrooms (*Pleurotus ostreatus*), *Makandura* white mushrooms (*Calocybe species*) and Abalone mushrooms (*Pleurotus cystidiosus*). Mushroom spread was packed in sterilized glass bottles and stored under refrigerated conditions. Mushroom fingers were vacuum packed and stored in freezer. The two value added products were evaluated for sensory attributes using nine-point hedonic scale, nutritional quality and shelf-life. Sensory evaluation was conducted by using 30 untrained panelists to select the best variety of mushroom for the preparation of mushroom fingers and spread. Mushroom fingers prepared using Oyster mushroom variety scored best ( $p < 0.05$ ) for overall acceptability whereas, mushroom spread prepared using Abalone mushroom variety had the highest ( $p < 0.05$ ) overall acceptability. Oyster mushroom fingers had a significantly higher ( $p < 0.05$ ) crude protein ( $6.71\% \pm 0.28$ ) and a significantly lower ( $p < 0.05$ ) crude fiber ( $0.26\% \pm 0.3$ ) and ether extract ( $5.1\% \pm 0.31$ ) contents compared to Abalone and *Makandura* mushroom fingers. Abalone mushroom spread had a significantly higher ( $p < 0.05$ ) crude protein content ( $9.80\% \pm 0.19$ ) than the Oyster and *Makandura* mushroom spread. Total plate count and yeast and mould counts were negative and pH values were not significantly ( $p > 0.05$ ) different for both products up to two months period. Thus in conclusion, Oyster mushroom and Abalone mushroom are the best among evaluated mushroom varieties for the preparation of mushroom fingers and spread respectively. These products can be stored up to two months without any changes in microbial properties.

**Keywords:** *Calocybe species*, Mushroom fingers, Mushroom spread, *Pleurotus cystidiosus*, *Pleurotus ostreatus*

## DETERMINING STORAGE STABILITY OF HARD DOUGH BISCUIT POWDER

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In biscuit production, non-conforming products are generated due to minor deviations from standard quality parameters. Those waste volumes are ground to powder which is currently used as ingredients in new manufacturing cycles in biscuit industry. The quality assurance of biscuit powder during the storage is vital. Hence this study was conducted to determine the storage stability of hard dough biscuits powder (HDBP). HDBP was stored for 5 weeks and at the end of each week a soft dough biscuit (B1, B2, B3, B4, B5 respectively) was prepared using the stored HDBP. Control product (C) was prepared using freshly grounded HDBP. They were stored under accelerated conditions (40°C and 90% relative humidity) for 7 weeks to determine the shelf life. Data were analyzed as a two-factor factorial complete randomized design for physicochemical properties (moisture, pH, free fatty acids (FFA), peroxide value (PV) and p-Anisidine) and microorganisms (total plate count (TPC), yeast and mold and *Escherichia coli* counts). Sensory properties were analyzed by Friedman test. Sensory properties of B1, B2, B3 did not show any significant differences ( $p > 0.05$ ) under accelerated conditions for 5 weeks compared to C. Moisture, FFA, PV and p-Anisidine were significantly ( $p > 0.05$ ) higher in B3 stored under accelerated conditions for 7 weeks ( $4.40\% \pm 0.02$ ,  $0.20\% \pm 0.03$ ,  $0.71 \text{ meq O}_2/\text{kg} \pm 0.18$  and  $1.90 \text{ AnV} \pm 0.14$  respectively), compared to B3 ( $1.74\% \pm 0.09$ ,  $0.16\% \pm 0.01$ ,  $0.12 \text{ meq O}_2/\text{kg} \pm 0.02$  and  $1.25 \text{ AnV} \pm 0.35$  respectively) and the pH significantly ( $p > 0.05$ ) decreased in B3 stored under accelerated conditions for 7 weeks ( $7.31 \pm 0.05$ ) compared to B3 ( $7.74 \pm 0.01$ ). TPC (max. 10 CFU/g), yeast (<10 CFU/g) and mold (<10 CFU/g) and *Escherichia coli* (not detected) counts were within the acceptable range of standards for biscuits. In conclusion, biscuits powder stored up to 3 weeks having desired physicochemical, microbiological and sensory properties could be used as an ingredient of biscuits manufacturing process.

**Keywords:** Physicochemical properties, Sensory Properties, Soft-dough biscuits

## EXTENDING THE SHELF LIFE OF TJC MANGO (*Mangifera indica*) BY THE APPLICATION OF 1-METHYLCYCLOPROPENE (1-MCP)

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Mango (*Mangifera indica*) is a climacteric and highly perishable fruit. Cultivar TomEJC (TJC) is an emerging mango variety that has a huge potential in the local and export markets due to its high quality. It requires specialized postharvest handling to extend storage life. This study was conducted to extend the shelf-life of TJC mango through the application of 1-MCP. Four dosages (1ppm and 12h, 2 ppm and 12 h, 1 ppm and 24 h, 2 ppm and 24 h) were tested with the control and stored at 14°C and 85-90% RH. The flesh colour, firmness, total soluble solids (TSS), pH, weight loss, rate of respiration and ethylene production were measured at the beginning of the storage study and during the storage at four days intervals. Application of 1-MCP showed a significant effect ( $p < 0.05$ ) on the flesh colour, firmness, TSS, pH, respiration and ethylene production. Initial  $a^*$  value in the flesh changed from -7.660.41 to -7.490.83, -5.751.69, -6.660.40, -2.652.31, -0.311.99 and initial  $b^*$  value 49.351.14 changed to 43.871.17, 49.681.44, 49.370.85, 55.492.12, 57.911.02 in treated samples and control respectively on 17d in storage. TSS changed from 6.830.06 to 15.10.1, 15.30.1, 15.30.1, 12.80.1 and 19.61.0. pH changed from 3.340.06 to 3.440.07, 3.430.08, 3.720.05, 4.080.08, 4.200.08 in samples while firmness decreased from 107.181.24 to 57.351.05, 91.731.30, 60.160.10, 32.720.68, 33.151.05 in the treated samples and control respectively in 17d storage. Physiological weight-loss percentage of the treated samples and the control was not significantly different ( $p > 0.05$ ) on 17d in storage. According to the sensory evaluation and TSS, treating TJC mango with 1-MCP was found to be successful in delaying of ripening since it extended the shelf life of mango from about 10d than the untreated mango. This study concluded that application of 2 ppm of 1-MCP for 12h could be recommended to extend the shelf life of TJC mango as it keeps the mango in good quality during one month of cold storage.

**Keywords:** 1-MCP, Quality, Respiration rate, Shelf life, TJC mango



**APPLICATION OF OZONE AS A POSTHARVEST TREATMENT FOR CONTROLLING BACTERIAL SOFT ROT IN CARROTS (*Daucus carota*)**

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Soft rot in carrot caused by *Erwinia carotovora* is one of the most serious postharvest diseases in Sri Lanka. It causes severe loss, especially during storage and transit. In this study, effects of ozonated water with different concentrations (5, 10, 15, 20, and 25 mg/L) were evaluated on the growth of *Erwinia carotovora in-vitro* and *in-vivo*. Preliminary studies were conducted to determine the best temperature and pH required for the growth of bacteria. The most effective ozonated water concentration was selected based on the reduction of bacterial total plate count. The effectiveness of the selected concentration was investigated on inoculated and naturally infected 3 replicate at 30°C and 4°C. Untreated and uninoculated tubers were considered as controls. Consumer acceptability, changes of the weight, total soluble solids (TSS), firmness, titratable acidity (TA), pH and colour of the carrots were evaluated using standard methods during the storage up to 7 days at 30°C ± 2 and 65 ± 5% RH. It was observed that the ozonated water at the concentration of 200 mg/L was significantly reduced the total plate count, therefore, it was used in the *in-vivo* experiments. Reduction in bacterial soft rot was observed in the concentration of 200ppm compared to the control and other ozone levels. Further, the curative effect of ozone on bacterial soft rot was prominent at 30°C ± 2 and 65 ± 5% RH. Moreover, the TSS, TA and firmness, pH, colour of the carrots treated with 200mg ozone/L were 15 ± 0.24 °Brix, 0.56 ± 0.01% and 132.74 ± 0.32N, 13.74 ± 2%, 13.74 ± 4.58% and 45.65 ± 15.21 while, in the control 10.8 ± 0.03°Brix, 0.36 ± 0.01%, 142.73 ± 0.89N, 17.22 ± 5.74, 47.88 ± 15.96, respectively. This study reveals that the ozone can be applied as a postharvest treatment to reduce the bacterial soft rot incidences of carrots.

**Key words:** Carrot, *Erwinia carotovora*, Ozonated water, Soft rot

## DEVELOPMENT OF A PROTOCOL FOR FREEZE PRESERVATION OF GREEN CHILLI (*Capsicum annum L.*)

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The development of an effective freeze preservation protocol for the harvested green chilli (*Capsicum annum L.*) is required to preserve production surplus of green chilli against possible quality losses and to improve its shelf life. The investigation was aimed at determining the effects of freeze preservation treatment in combination with blanching pretreatment followed by the storage at normal freezing condition ( $-18^{\circ}\text{C} \pm 2$ ) to establish an optimum freeze preservation protocol for green chilli. Blanching and unblanching green chilli were respectively subjected to normal freeze preservation ( $-18^{\circ}\text{C} \pm 2$ ) and blast freeze preservation ( $-30^{\circ}\text{C} \pm 2$ ) and all the samples were kept in freezing conditions. Changes in colour, pH, total soluble solids (TSS) and total chlorophyll contents (TCC) were measured immediately after each treatment and at a weekly interval for a storage period of six weeks. The results of the four treatments were analyzed using two factor factorial completely randomized design. Parametric data were statistically analyzed using SAS and mean separation was done by Tukey's test. The colour, pH, TSS, total chlorophyll contents (TCC) were significantly ( $p < 0.05$ ) affected by the treatments as well as with the storage time. The pH of all treatments increased significantly after six weeks of storage period. During sixth week TSS were not significantly ( $p > 0.05$ ) different among treatments. Total soluble solids in unblanching blast frozen chilli were significantly higher throughout storage. Total chlorophyll contents were significantly higher in normal frozen chilli than in blast frozen chilli at sixth week of storage. The rating for the visual quality depicted that unblanching blast frozen chilli retained a higher acceptability throughout storage. It could be concluded that unblanching blast freezing had a potential to be utilized as a protocol to adopt in freeze preservation of green chilli

**Keywords:** Blanching, Blast freezing, Chilli, Normal freezing

**QUALITY ASSESSMENT OF RICE BEVERAGE MADE FROM  
TRADITIONAL RICE VARIETIES FERMENTED BY *Lactobacillus  
plantarum***

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This study was conducted to investigate the fermentation characteristics and suitability of traditional rice flour for fermented beverage production using four traditional rice varieties. Fermented rice beverage was prepared using *Lactobacillus plantarum* (2%) as a probiotic bacterium. Rice varieties: *Suwandel*, *Pachchaperumal*, *Kalu heenati*, and *Madathawalu* were used with 1:12 rice flour to water ratio to develop the fermented rice beverage. The best variety was selected by a sensory evaluation with thirty untrained panelists using nine-point hedonic scale after one day of production. Titratable acidity (TA), pH, Total soluble solid (TSS), probiotic counts and yeast & mould counts of the fermented rice beverage samples were tested during the storage (4°C, 3 weeks). Parametric and sensory data were analyzed using two-way ANOVA Completely Randomized Design (CRD) and Friedman test, respectively. After one day of storage, pH and TSS was significantly decrease and TA was significantly increase in all rice varieties. *Suwandel* variety resulted in the best sensory properties for color, aroma, texture, taste and overall acceptability ( $p < 0.05$ ). There was a significantly higher pH and lower TA in *Suwandel* variety among other rice varieties. Furthermore, the TSS of *Suwandel* was significantly higher after 1 week of storage among other rice varieties. The probiotic count of all samples was beyond the threshold of minimum therapeutic value ( $10^6$  CFUml<sup>-1</sup>). There was an increase of probiotic bacteria count till 6<sup>th</sup> day of storage and decrease thereafter. Therefore, these results infer that it is healthier to consuming fermented rice beverage up to 1 week of storage period. Yeast and mold count of all rice beverage samples was within the acceptable range ( $< 1000$  CFUml<sup>-1</sup>) during the 3 weeks of storage period. According to the results, *Suwandel* variety could be effectively used to produce fermented rice beverage without quality deterioration for 3 weeks storage at 4 °C.

**Keywords:** *Lactobacillus plantarum*, Probiotic, Rice beverage, Traditional rice varieties

**DEVELOPMENT AND EVALUATION OF SET YOGHURT BY USING PROBIOTIC CULTURE (*Lactobacillus paracasei* and *Lactobacillus rhamnosus*) AS A BIO-PRESERVATIVE**

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Yoghurt is one of the most popular food, produced by bacterial fermentation of milk which plays a major role in dairy industry. The objective of this study was to evaluate the effect of bio-preservative cultures (*Lactobacillus paracasei* and *Lactobacillus rhamnosus*) on physicochemical, microbiological and sensory properties of set yoghurt. Yoghurt incorporated with Potassium sorbate was used as the control. All the yoghurt samples were prepared with three replicates using fresh cow milk having 3.7% fat content with thermophilic starter cultures. Samples were stored at 4°C for 28 days and all physicochemical and microbial properties were evaluated at weekly intervals. Sensory evaluation was conducted using day old produce up to 28 days at weekly intervals. Parametric data were statistically analyzed using SAS program. The organoleptic data were analyzed by Friedman test using MINITAB. There was no significant difference ( $p>0.05$ ) in the titratable acidity and pH between Bio preservative added yoghurt sample and the control. Sensory data revealed that replacing Bio preservative has no significance effect ( $p>0.05$ ) on the overall acceptability of yoghurt during the storage time. Coliform was not detected and yeast (<1000 cfu/g) and mold (<1 cfu/g) counts were within the acceptable level over the storage period of 28 days at refrigerated storage. This study concluded that the Bio-preservative culture could be used instead of the chemical preservative (Potassium sorbate) in commercial yoghurt production.

**Keywords:** Bio-preservation, Bio-protective culture, Physicochemical properties, Yoghurt



## **USE OF MILK PROTEIN ISOLATE TO IMPROVE THE TEXTURAL PROPERTIES OF CURD**

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Commercial curd manufactures are used to add gelatine in curd production to obtain better textural properties while avoiding the defects like poor mouth feel. However, according to food standards and Ministry of Health in Sri Lanka, addition of gelatine into curd is banned. Therefore, the objective of this study was to evaluate the effectiveness of Milk Protein Isolate (MPI) on improved textural properties of curds. Four different levels of MPI as 0.5%, 1%, 1.5% and 2% were compared with control curd sample which was produced by adding milk powder instead of MPI. Physicochemical properties including pH, titratable acidity, syneresis were measured during the shelf life of 14 days. Hardness, chewiness and adhesiveness were assessed as textural properties. Microbiological safety was analysed during the shelf life of 14 days using coliform, yeast and mold counts. Sensory evaluation was carried out using 30 untrained panellists to evaluate the organoleptic properties of curd using colour, appearance, flavour, aroma, texture and spoon ability. Parametric, nonparametric data were analysed by ANOVA in SAS and Friedman test, respectively. Results showed that all the textural properties including hardness, chewiness and adhesiveness were significantly different ( $p < 0.05$ ) among the treatments while the highest mean values were recorded in the 2% MPI added curd samples. There was no significant difference ( $p > 0.05$ ) for pH and titratable acidity among the treatments. Curd developed with 2% MPI had the lowest syneresis compared to other treatments. According to the sensory evaluation results, appearance, texture and spoon ability were also much better in the 2% MPI treatment. Microbiological analysis showed that coliform was not observed during the storage period while yeast and mould growth were below the safe levels in all treatments. In conclusion, 2% MPI could be effectively used to replace gelatine like constituents in curd while enhancing the textural properties and consumer acceptance.

**Key words:** Curd, Milk protein isolate, Spoon ability, Texture

**DEVELOPMENT OF A PROTOCOL FOR ARTIFICIAL RIPENING OF  
EMBUL BANANA (*Musa* spp.) IN SRI LANKA**

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Banana (*Musa* spp.) ripening is generally practised using artificial ripening methods. However, problems are created due to overuse, time of exposure and method of application of artificial ripening agents. An experiment was carried out to develop a protocol for artificial ripening of *Embul* banana by optimizing the chemical usage and exposure time. Two-factor factorial experiment in a completely randomized design and peel appearance, flesh appearance, taste, odour and overall acceptability were assessed using a sensory evaluation using thirty untrained panelists were conducted. *Embul* banana at correct maturity were treated using three ethephon concentrations; 100, 150 and 200 ppm combined with three exposure durations; 12, 18 and 24 hours (h) in a ripening chamber. The untreated banana was used as the control. All banana was kept for 6 days at the storage temperature of 30°C ± 2. Firmness, pH, total soluble solids (TSS), ascorbic acid content (AAC), colour and total chlorophyll content (TCC) of banana were assessed in the initial day and in one-day interval basis at the storage. TSS was significantly ( $p < 0.05$ ) higher at the 2<sup>nd</sup> day of storage in 200 ppm treated for 24 h (24.80±0.44) followed by 200 ppm treated for 18 h (21.73±1.32) compared to control (9.32±0.97). Firmness was significantly ( $p < 0.05$ ) lower at the 2<sup>nd</sup> day of storage in 200 ppm treated for 24 h and 18 h (7.39N ± 0.73 and 12.43N ± 3.06 respectively) compared to control (38.47N±4.17). The samples treated with 200 ppm for 18 h and 24 h had 6 and 5 days of shelf life respectively, where 75% of the fruits were over ripen. Results of the sensory analysis revealed that 200 ppm treated for 18 h had the significantly ( $p < 0.05$ ) higher consumer acceptance. Consequently, it is concluded that the ethephon concentration of 200 ppm for 18 h could be recommended dosage to accelerate ripening of *Embul* banana with longer shelf life.

**Keywords:** Ethephon, Exposure time, Storage duration

## EVALUATION OF THE COMMERCIAL APPLICABILITY OF ORGANIC RIPENING AGENT

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Use of chemicals on artificial ripening of fresh fruits has become a debated issue and alternatives are being investigated. Previous studies have reported, leaf powder of Bilin (*Averrhoa bilimbi L.*) and Keppetiya (*Croton lacciferus L.*) 1:1 ratio induce ripening of banana. Based on the results of the previous study, this study was focused on determining the optimum amount of leaf powder mix (LPM - 1:1 ratio of Bilin: Keppetiya) per fruit weight to induce ripening of banana and to investigate its commercial applicability in small scale condition. Emanations of LPM were analyzed by gas chromatography (GC). Banana variety *Embul* was harvested at mature green stage (Total soluble solids (TSS) 7.10 0.05° Brix) and exposed to four levels of LPM, namely 0% (control), 1%, 2% and 3% per fruit weight and kept for 24 h in airtight condition. Data on peel color, firmness, TSS, Titratable Acidity (TA), pH and physiological weight loss (PWL) were measured daily until it reached to the table ripening stage. Further, banana hands were packed as small scale commercial condition and four packs of 3% LPM (w/w) were kept inside with non-treated control. After 24 h, fruits were removed and visual quality rating (VQR) and ripening index (RI) were observed daily for a week. The results revealed that ethylene gas was not detected by the GC. Further, 3% (w/w) LPM had significantly ( $p < 0.05$ ) different peel colour ( $L^* = 74.45 \pm 0.38$ ,  $a^* = -1.63 \pm 0.24$ ,  $b^* = 74.45 \pm 0.38$ ), firmness ( $3.63 \pm 0.13$ ), TSS ( $24.67 \pm 0.15$ ), TA ( $0.7 \pm 0.01$ ), pH ( $4.3 \pm 0.01$ ) and PWL ( $0.11 \pm 0.04$ ) than the control. However, VQR and RI of treated samples were similar to the control ( $p > 0.05$ ). Hence, it is recommended 3% (w/w) leaf powder mix for the ripening of banana and further investigations are required at commercial scale.

**keywords:** *Averrhoa bilimbi*, Banana, *Croton lacciferus*, Ripening

**DEVELOPMENT OF A PROTOCOL FOR ARTIFICIAL RIPENING OF  
TAINUNG NO 01 PAPAYA (*Carica papaya* L)**

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Papaya (*Carica papaya* L) is one of the demanding fruit in which both natural and artificial ripening are practiced. But use of artificial ripening agents boost ripening process followed by rapid senescence. Therefore, this study was conducted to develop a protocol for artificial ripening of papaya in order to reduce post harvest losses in destination markets. Tainung No 01 papaya in their commercial maturity were subjected to ethephon concentrations of 150 ppm, 200 ppm and 250 ppm for exposure time periods of 12 h, 18 h and 24 h in an artificial ripening chamber according to the two factor factorial completely randomized design. An untreated sample was kept as control. After giving treatment they were allowed to ripe at ambient condition ( $30 \pm 2^{\circ}\text{C}$ , RH 75%-85%). During the ripening period, physicochemical parameters such as peel colour, firmness, pH, Total Soluble Solids (TSS), titratable acidity, Total Chlorophyll Content and the physiological parameters such as respiration rate and  $\text{O}_2$  emission rate were analyzed in 1 day interval. A sensory evaluation was conducted to evaluate the perception of peel colour, flesh colour, odor, taste and overall acceptability with 30 untrained panelists using five-point hedonic scale. There was a significant difference ( $p < 0.05$ ) within the treatments and storage in all the evaluated parameters. The treatment exposed to 250 ppm for 12 h exhibited a significant decrease in firmness from  $126.44 \pm 5.45$  to  $51.2 \pm 3.54$  while the control decreases to  $109.90 \pm 8.32$  after the 4<sup>th</sup> day of the treatment. Meanwhile the TSS significantly increased from  $10.66 \pm 0.65$  to  $12.07 \pm 0.06$  in above mentioned time period. Further, the highest sensory perception was also observed in same treatment. This result of the study reveals that 250 ppm ethephon concentration exposed for 12 h could be used in ripening of papaya in terms of safeguarding quality and storability.

**Keywords:** Artificial ripening, Ethephon, Papaya, Quality, Storability



## DEVELOPMENT OF LESS SWEET FIBER-ENRICHED DRINKING YOGURT BY USING SOLUBLE DIETARY FIBER AS A STABILIZER

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With a growing interest in health-promoting functional foods, the demand for natural additives has increased worldwide. The aim of this study was to develop a less sweet fiber-enriched yogurt drink by adding soluble dietary fiber which is a natural stabilizing agent. First study was conducted to select the best sugar level among four different sugar levels (0, 3, 6, and 9% w/v), where 9% (w/v) was found to be the most acceptable by the sensory evaluation. The second study was conducted to evaluate the effect of soluble dietary fiber levels (3, 3.5, and 4% w/v) in terms of physicochemical and sensory properties, together with the selected sugar content for the production of a less sweet fiber-enriched yogurt. Finally, the selected soluble dietary fiber level was compared with a synthetic stabilizer, gelatin (0.45% w/v), and an authenticated control which did not contain any stabilizers. Physicochemical properties and microbiological properties of drinking yogurts were determined for four weeks of duration. Parametric and nonparametric data were analyzed using one-way ANOVA completely randomized design and Friedman test, respectively. The 3% (w/v) soluble dietary fiber level was selected among three different soluble dietary fiber levels due to its superior sensory properties. Titratable acidity, pH and brix value of 3% (w/v) soluble dietary fiber level was  $0.9125 \pm 0.01$ ,  $0.43 \pm 0.01$  and  $19.25 \pm 0.05$  respectively. The highest overall acceptability resulted in 3% (w/v) soluble dietary fiber incorporated yogurt drink compared to the gelatin and the control yogurt drink. Ash, protein, syneresis were significantly lower and water holding capacity was significant higher in less sweet fiber-enriched yogurt drink compared to gelatin and control yogurt drinks. *Escherichia coli* was not detected in all levels of stabilizer, while yeast and mold count of yogurt drinks were within the acceptable range (maximum  $1 \times 10^3$  CFU/g) during the storage period. In conclusion, less sweet soluble dietary fiber could be effectively incorporated to develop a yogurt with desired physicochemical, rheological, microbiological and sensory properties and shelf life.

**Keywords:** Drinking yogurt, Gelatin, Microbiological properties, Sensory properties, Sugar content