

Study on developing micronutrients enriched spread using fermented cooked rice

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Abstract— Most of the people in the world today suffer from micronutrient deficiencies caused largely by a dietary deficiency of vitamins and minerals. The objective of the present study was to develop the micronutrient enriched spread using fermented cooked rice, using the raw materials available in Sri Lanka named by Red rice, Tomato, Chick pea, Spices, Corn flour, Salt, Sugar, Coconut oil and Bee's honey. The cooked rice was fermented overnight and dried at 65-66 °C for 24 hours (without deterioration of Vitamin B₁₂). The powdered dried rice mixed with tomato pulp, powdered spices (Garlic, Cardamom, Cloves, Mustard, Chili, Black pepper), corn flour, Chickpea flour, sugar, salt, coconut oil and Bee's honey in different formulations. Four formulations were prepared to select the best spicy blend and other four formulations were prepared with the selected spicy blend to obtain best formulae for the final product. Sensory analysis was carried out using 30 untrained panelists and the results were analyzed using Kruskal-Wallis test in MINITAB software and the formula 244 selected as the best formula with respect to all sensory properties. The *Lactobacillus* group was isolated and identified from fermented cooked rice after 12 hours fermentation period (According to ISO 15214, 1998). The proximate composition of product number 244 was contained 43± 0.002% moisture, 5.7±0.6% crude protein, 5.2±0.08% Total fat, 4.1± 0.057% Ash, 3.3± 0.011% Crude fiber and 39.6% carbohydrate. Micronutrient content of 100 g of final product was 2.3 µg of Vitamin B₁₂, 40 mg of ascorbic acid, and 820.78mg of Na, 826.09mg of K, 64.25mg of Fe, 9.74 mg of Zn, 167.79 mg of Mg and 184.94 mg of Ca. The fatty acid profile of the final sample was 4.451% of capric acid, 47.50% of lauric acid, 17.49% of palmitic acid, 9.74% of linoleic acid, 16.31% of oleic acid, 0.14% of stearic acid and 4.24% of erucic acid. The shelf life analysis for the final product was carried out and the sensory attributes and microbiological counts were in the acceptable levels within 30 days under the refrigerated condition.

Index Terms— Fermented cooked rice, Micronutrients, *Lactobacillus*, Vitamin B₁₂

I. INTRODUCTION

Rice (*Oryza sativa* L., family Gramineae) is the most widely consumed basic foodstuff in the world (Khush, 1997). Most people in Asian countries consume cooked rice as their main meal. The remaining quantity of cooked rice is soaked in water in a covered container and kept overnight for fermentation process and converted to fermented cooked rice. Fermented cooked rice is a

traditional food widely-consumed in Asian countries is referred to as *Diyabath* in Sri Lanka and *Poita bhat* in Assam, *Panta bhath* in Bengal and *Pokhalo* in Orissa. This nutritious food is rich in Vitamins and can be considered as micro nutrients supplement food. This is a food rich in energy with all natural nutritional supplements which comes from the fermenting bacteria in it. The advantage of this food is trillions of bacteria that produce copious amount of Vitamin B complex such as vitamin B₁₂ (a good source for vegetarians). The lactic acid bacteria having the potential of removing anti-nutritional factors in cooked rice during the fermentation period.

The main objective of this study was to develop a spread rich in micronutrients using fermented cooked rice. The specific objectives were, identification of Lactic acid bacteria group available in fermented cooked rice (after 12 hours incubation period), finding a method to extend the shelf life of fermented cooked rice without deteriorates of vitamin B₁₂, determination of the best combination of ingredients to develop the micronutrient enriched spread, determination of the nutritional profile and determination of the microbial safety in relation to the shelf life of the final product were carried out.

II. METHODOLOGY

The raw materials for the preparation of micronutrients enriched spread, were Sri Lankan red rice(raw), Tomato, Chick pea, Corn flour, Garlic, Cardamom, Cloves, Mustard, Black pepper, Chili powder, Corn flour, Salt, Sugar, Coconut oil and Bee honey. The cooked rice was fermented by soaked in water in a closed container, kept for 12hours in a steady condition. The fermented rice was dried at 65-66 °C for 24 hours in a drying oven. Then the dried rice was converted into powder through grinding and sieving. The tomato pulp was prepared through hot break process. All the spices were converted into powder forms and corn flour, sugar, salt, coconut oil and bee honey taken from the local market. The ingredients were mixed in different formulation to obtain selected four samples and the two sensory analysis were carried out using 30 untrained panelists to select the best spicy blend formulation and the best recipe for the final product. The results of the sensory analysis were analyzed using Kruskal-Wallis test in MINITAB software (14).

Isolation of *Lactobacillus* bacteria group in fermented cooked rice was carried out using De man Ragosa Sharpe agar medium (pH 5.7 at 10 °C-30 °C) according to ISO method(ISO 15214, 1998). For identification and confirmation of *Lactobacillus* bacteria group, Gram staining, Catalase test, Oxidase test and Motility tests were carried out. Moisture, Ash, Crude protein, Total Fat,

Crude fiber contents of the final product were analyzed by A.O.A.C methods (AOAC, 1999). Determination of mineral content was carried out by Atomic Absorption Spectrophotometer (AAS) and the total fatty acid profile of the final product was analyzed with Gas chromatography/Mass spectrometry (GC/MS). The vitamin B₁₂ content was analyzed according to Roche Publication Index; No 2101 method by High performance liquid chromatography technique. To determine the shelf life of the final product, the pH value (according to SLS, 1972), the peroxide value and the microbiological analysis (Yeast and mold, Presumptive coliform, Total plate count; according to SLS, 1991) were carried out during the 6 weeks of storage time period.

III. RESULTS AND DISCUSSION

According to the results of sensory evaluation to select the best spicy blend formulation, the formula 147 was gained the highest consumer preference for all the sensory parameters and it was selected as the best spicy blend formulae.

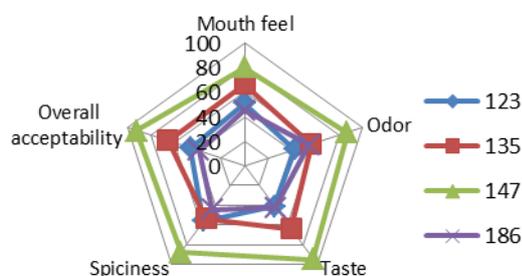


Fig 1: Descriptive rating chart for sensory evaluation for selection of the best formula for the spicy blend

In sensory evaluation results for selecting the best recipe for the final product, the formula 244 was significantly different (average rank difference > mean separation value) from all other three formulas in taste, odor, appearance, mouth feel and overall acceptability sensory parameters. In spreadability parameter, the formula 244 was not significantly different with formula 264. According to the descriptive rating chart the formula 244 was selected as the best recipe for the final product.

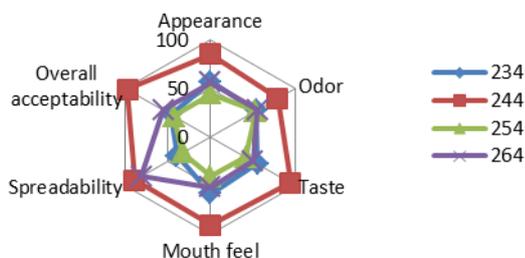


Fig 2: Descriptive rating chart of sensory evaluation for select the best recipe for final product

According to the results of isolation, identification and confirmation tests of *Lactobacillus* bacteria group, gram

positive, catalase negative, oxidase negative and non motile bacteria group was isolated and identified and the presence of *Lactobacillus* group bacteria in fermented cooked rice after 12 hours fermentation period was confirmed.

According to the results of proximate analysis, the 100 g of the final product was contained 43± 0.002% moisture, 5.7±0.6% crude protein, 5.2±0.08% Total fat, 4.1± 0.057% Ash, 3.3± 0.011% Crude fiber and 39.6% carbohydrate. The fatty acid content of the 100 g of the final sample consists of 4.45% of Capric acid, 47.50% of Lauric acid, 17.49% of Palmitic acid, 9.74% of Linoleic acid, 16.31% of Oleic acid, 0.14% of Stearic acid and 4.24% of Erucic acid as major fatty acids.

Also 100g of final product contained 2.3 µg of Vitamin B₁₂, 40 mg ± 0.002 of ascorbic acid, and 820.78 mg ± 0.011 of Na, 826.09 mg ± 0.011 of K, 64.25mg ± 0.061 of Fe, 9.74 mg ± 0.002 of Zn, 167.79 mg ± 0.001 of Mg and 184.94 mg ± 0.010 of Ca as the micronutrients. According to the results the final product was enriched in micro minerals and vitamins.

Microbiological analysis within one month period revealed that total plate count (<10⁴ cfu/g), yeast and mold count (<10² cfu/g) and presumptive coliform count (<10² cfu/g) were within the acceptable limits within 6 weeks under the refrigerated condition and pH variation was not affected to the final product quality and the peroxide value was negligible within the 6 weeks of storage time period.

IV. CONCLUSIONS

A value added micronutrients enriched spread was developed using preserved fermented cooked rice flour, tomato, chickpea flour, bee honey, coconut oil and spices.

TABLE 1: INGREDIENT FORMULA OF THE FINAL PRODUCT

Ingredients	Quantity (g/%)
Fermented rice flour	30
Chickpea flour	2.5
Corn flour	2.5
Tomato pulp	20
Garlic powder	2.4
Cloves	0.16
Cardamom	0.2
Chili powder	2.4
Black pepper powder	0.2
Mustard powder	0.64
Salt	8
Sugar	24
Coconut oil	3.5
Bee honey	3.3

The drying technique can be used to preserve fermented cooked rice (drying at 65-66^oC for 24 hours) without deterioration of Vitamin B₁₂. The *Lactobacillus* group which is a major lactic acid bacteria group was isolated and identified from fermented cooked rice. Considering the nutritional profile of the final product it can be recommended as the micronutrient enriched product which was in highly satisfactory levels in nutritionally with other spreads available in the market. The product is microbiologically stable and safe within one month and half month of time period at the refrigerated storage conditions.

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