American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Formulation of Functional Yogurt by Cofermentation of Milk and Papaya Fruit

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Abstract

This study was carried out to determine the potential of adding Fresh skinned papaya pulp (FSP) into yoghurt for the improvement of the functional properties of yoghurt and the resulting effects of adding PPF on the physicochemical and sensory properties of the product during a 30 days' storage period at 6°C. Yoghurt samples A (Control), B, C, D and E were respectively produced at 0%, 5%, 10%, 15%, and 20% of milk incorporated with papaya fruit. Incorporation of PPF into the yogurt samples resulted in an increase in pH, proteins and carbohydrates and a reduction in titratable acidity as compared to the control. The microbial analysis showed no presence of coliform bacteria. The sensory evaluation result demonstrated significant differences in all the organoleptic attributes analyzed. Sample C with 10% incorporated papaya had the highest overall acceptability score.

Keywords: Papaya fruit; Milk; Cofermentation; Functional yogurt; Sensory analysis.

1. Introduction

Milk is an important food of diet for a vast population on earth, due to its high nutritional value for human beings. It is considered functional food when it is developed specifically to promote health or reduce the risk of diseases. Functional foods include foods that contain specific minerals, vitamins, fatty acids or dietary fibers. Functional foods are foods with biologically active substances such as phytochemicals and those that can support beneficial microbial cultures of interest.

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Also in these category specific minerals, vitamins, fatty acids and dietary fibers are found. Recent research is shifting focus to diverse components in dairy food, in particular fermented dairy products [1]. Yoghurt is fermented milk that results from the symbiotic activity of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*. Much health benefits of yoghurt have been attributed to their composition. Although yoghurt has medical uses because Probiotics can stimulate the immune system, decrease serum cholesterol, alleviate lactose intolerance, decrease diarrheal incidence, control infections, act as antibiotics, suppress tumors and protect against colon/bladder cancer [2]. The probiotics have the potential to solve numerous diseases such as gastrointestinal problems, lactose intolerance, treatment of acute diarrhea, cancer, diabetes, prevention and treatment of allergy related problems [3]. Contrary to public opinion, Papaya (*Carica papaya*) has an exceptional nutritional and medicinal property throughout the world. The whole plant including its fruit, leaves, seed, root, bark, juice and latex obtained from papaya plant are used as nutrients, medicine and for various other purposes [4]. The many benefits of papaya are due to high content of vitamin A,B and C, proteolytic enzymes like papain and chymopapain which have antiviral, antifungal and antibacterial properties . The fruit is an excellent source of beta carotene that prevents damage caused by free radicals that may cause some forms of cancer. It is reported that it helped in the prevention of diabetic heart disease [5]. In the fermented condition, fruit produces 20 times more antioxidants compared to vitamin E. This property allows it to strengthen the immune system of people living with HIV and vital hepatitis C and prevent cancer [6]. The consumption of symbiotic foods that contain prebiotics and probiotics offers added nutritional benefits that can help boost overall health and well-being [7]. The fermented papaya enriches the yoghurt with antioxidants, essential amino acids, minerals and vitamins. With these, the yogurt will help in the prevention of certain pathologies of public health concern. Thus, the objective of this study is to produce functional yoghurt enriched with papaya fruit and to determine the physicochemical, nutritional, microbial, sensory qualities and overall acceptability of the product.

2. Materials and method

2.1. Raw material procurement

Figure 1: Raw material, milk & papaya fruit

The fresh ripe papaya was obtained from Edzendouan farm; commercial yoghurt, powdered full cream milk (LP) were obtained from Mfoundi and Essos market in Yaounde Cameroon. The processing was done in a strict hygienic laboratory environment at laboratory for research in food safety of the University of Yaounde 1.

2.2. Production of enriched papaya yoghurt

The papaya fruits were washed with potable water to remove all dirt. After which they were peeled to remove the skin and divided vertically into 4 slices to eliminate the pips. They were then chopped into pieces before crushed to fine particles with a Moulinex. It was heated at 90°C for 3 minutes to reduce pathogenic microorganisms, then the 0%, 5%, 10%, 15%, 20% portions were added to the initially pasteurized milk powder for the rest of the process. These were labeled as samples A (control), B, C, D and E respectively (Table 1).

Table 1: Formulation of enriched yoghurt

Yoghurt sample	A	B	C	D	E
papaya (g)	0	5	10	15	20
Milk (l)	1	0.95	0.90	0.85	0.80
Water (l)	1	1	1	1	1
Starter culture (g)	0.3	0.3	0.3	0.3	0.3

The milk was heated to about 90°C to kill any undesirable bacteria and to partially break down the milk proteins. The samples were cooled to about 45°C. The starter culture (0.3 g) of *L. bulgaricus* and *S. thermophilus* was activated at 45°C of two hours. This active culture was used to inoculate each of the 1 liter (1,000 ml) papaya-milk slurries, at the same temperature of 45°C which was maintained for 2-3 hours to allow for fermentation and the rapid production of lactic-acid by the inoculated bacteria, which led to the coagulation of the milk. The yoghurts produced were cooled rapidly at 6±2°C and refrigerated for subsequent analysis. The Flow chart of enriched papaya yoghurt is presented in figure 2 bellow.

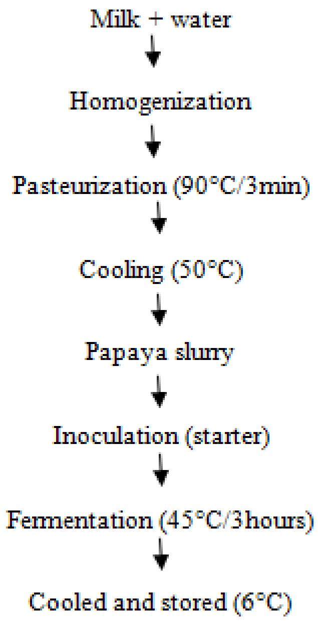

Figure 2: Flow chart of cofermented papaya yoghurt

2.3. Physico-Chemical Analysis

The pH was determined using a Mettler Toledo model pH meter according to manufacture protocol. The acidity was determined by titration against 0.1M sodium hydroxide using phenolphthalein indicator. The proximate composition of the yoghurt samples was also determined by these methods: The moisture contents by drying method by weight differential, the protein contents were determined using Bradford Method [8]. Carbohydrate content was determined using Michel Dubois method [9]. The total lipid according to the mathematical formula: Fat= [Dry Matter-(Protein Carbohydrate)] and energy according to the formula: Energy= (4xProtein+ 4xCabohydrate +9x Lipid).

2.4. Microbiological Analysis

The determination of the microbial contamination of the yoghurts was performed by using; Mac Conkey agar for the coliform and selective enriched SS Agar for Salmonella and Shigella bacteria. The colonies were counted and the results were expressed as colony forming unit per ml. (cfu/ml).

2.5. Sensory Analysis

The different samples and two commercial Yoghurts (Yc1 and Yc2) were presented to a panel of experienced tasters, regular yoghurt consumers and university students. The sensory procedure described by Djoulde was modified in this study [10]. Each taster was given an evaluation form for each of the fermented milk samples. The form included five sensory attributes: taste, aroma, color, aspect, and texture. Panelists were asked to assess the samples in terms of the listed attributes using a nine-point hedonic scale with 9 representing like extremely and 1 indicating dislike extremely. The tasting was carried out at the sensory room in the Food Safety Research Laboratory. Tasters were provided with water and tea to rinse their mouth and smell respectively after each round of tasting and were prevented from communicating with each other to avoid influential biases. Each taster was served with 15 ml of each sample in different coded form.

3. Results and Discussion

The data presented in this section is that of the first day. The physico-chemical parameters analyzed for the yoghurt samples are summarized in Table 2. The pH values of the yoghurt samples ranged from 4.4 to 5.0 which goes in the same direction as the works of (Amal and his colleagues 2016), therefore the pH varies between 4.6 to 4.74 Sample A had the lowest value, when compared with the papaya enriched samples (B, C, D and E). Lactic acid bacteria produce lactic acid during fermentation of milk- lactose, thus lowering the pH [11]. The pH of papaya fruit was 8±1. However, the papaya had a slight modification on the rate of lactic bacteria activity hence the increase in the pH of the samples B, C, D and E. research carried out in the same context in Egypt has shown a drop in the pH of papaya (4,9) [12]. The acidity also ranged from 90 °D to 60°D in the yoghurt samples (Table 2). The enriched papaya yoghurt samples (B, C, D, and E) had lower acidity values (60-85°D) than control (90°D). This could be due to more availability of lactose to the fermenting microbes [1]. FAO (Food and Agricultural Organization) standard code requires that the acidity of yoghurt be between 75°D to 1°D, this can prevent the growth of pathogenic microorganism [12]. They showed a decrease in pH of sample C between the 1st day (4.5) and 30th (3.0) and an increase in acidity (80°D to 150°D). The water content increases with the addition of papaya from 86 for the control, to 88 for sample D (20%). This shows that the papaya is very rich in water and the latter is added to that of the milk during the fermentation process. Nutritional analysis was performed only with sample C compared to control A because it was most appreciated by the tasting panel.

3.1. Nutritional analysis

They were no significant difference in nutritional values between the 1st and 30th day. However, sample C showed a slight increase in protein and carbohydrate levels (5.4 ± 2.0), respectively (5.4 ± 0.7) as compared to the control A (5.2 ± 2.0), (5.0 ± 0.7). This is due to the main contribution of proteins and carbohydrates from the papaya. Lipids have rather opposite effects with a slight decrease in sample C (3.2 ± 0.4) as compared to the control A (3.3 ± 0.4) showing the very low composition of the papaya in fatty acids which is consistent with the results of (Amal and his colleagues 2016). Table 3 shows the physicochemical composition of samples A, C and commercial Yogurt Yc. Sample C has a very low sugar level (5.4 ± 0.7) as compared to Yc (6.6 ± 0.7). This is due to the fact that agro-food industries are adding more sugars in their products to increase sweetness. The protein and lipid levels are almost identical in both cases.

Table 2: pH and Acidity of the yogurt sample

Sample	A	B	C	D	E
Ph	4.4	4.4	4.5	4.8	5.0
Acidity (°D)	90	85	80	70	60

Table 3: Nutritional values of the different yoghurt (control A, sample C and commercial Yc)

Yoghurt sample	A	C	Yc
Proteins (g)	5.2±2.0	5.4±2.0	5.3±2.0
Carbohydrates (g)	5.0±0.7	5.4±0.7	6.6±0.7
Fat (g)	3.3±0.4	3.2±0.4	3.1±0.4

3.2. Microbial content

The absence of coliform bacteria signifies that the yoghurt samples are free from faecal contamination due the hygienic conditions employed during production [1].

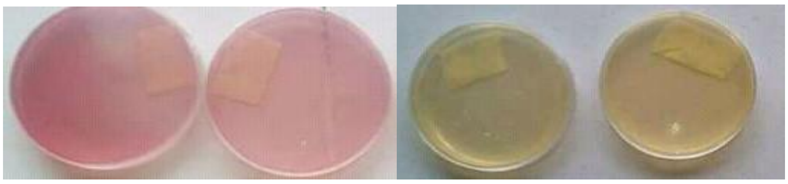

Figure 3: Microbial analysis of Cofermented Papaya Yogurt

3.3. Sensory analysis

Sample C (10%) scored better in taste, aroma and color (9) as compared to the control A (8). The control A and the sample B scored better in texture and an appreciable good appearance. Samples D and E scored low compared to the rest of the samples. It can also be seen that sample C (10%) was almost equivalent to the commercial standard. It turns out the addition of papaya pulp brings a big change in the sensory properties of yoghurt to a maximum of 10%. This may be due to the activity of lactic acid bacteria which, during the fermentation process, degrade papaya compounds and reinforce the Aroma of yoghurt. The properties of fruits can be exploited to It is in the same lines as the result of (Amal and his colleagues 2016) Substitute synthetic flavors that are less beneficial to our health. The sensory properties of sample C were consistent during a period of 30 days. (Taste, Texture; Aroma and Color).

This results of the sensory analysis are represented on figure 4 below.

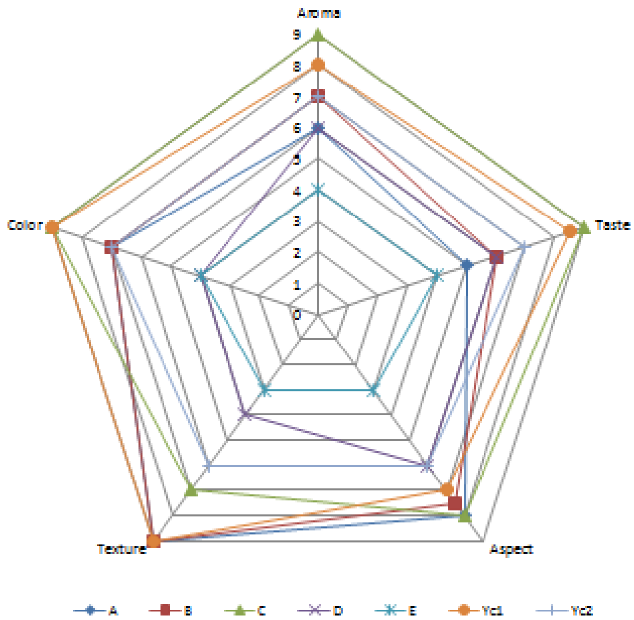

Figure 4: Sensory analysis of Cofermented Papaya Yoghurt

4. Conclusion

This study which was aimed at producing a stable functional yogurt enriched with papaya, resulted as a better nutritional and an appreciably better sensory acceptability compared to the control and the commercial standard.

Acknowledgment

Jocelyn Lee, Food Safety Consultant - Contributing Editor www.linkedin.com/in/jocelynleefoodsafetyconsultant

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