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FORMULATION AND NUTRITIONAL ANALYSIS OF JACKFRUIT YOGURT

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Abstract

The study was designed to produce fruit juice yogurt by addition of jackfruit juice as partial ingredient which is nutritious as well as delicious food. An investigation was carried out to develop the acceptable prepared yogurt using different level (2%, 4%, 6%, 6.5%, 7%, 7.5%, 8% and 10%) of jackfruit juice. The prepared samples were evaluated for sensory quality by Hedonic Rating Test. Furthermore, the formulated jackfruit yogurt was compared with the plain yogurt in terms of chemical composition. The sensory evaluation revealed that the jackfruit yogurt formulated with 93.5% milk, 12% sugar and 6.5% jackfruit juice was most acceptable in terms of color, flavor, texture, taste preferences and overall acceptability and ranked as "Like Much". Whether samples formulated with 4% and 6% jackfruit juice along with 12% sugar and 96% and 94% milk respectively were equally acceptable and ranked as "Like moderately". But the rest of the formulated sample which contained 7%, 8% and 10% jackfruit juice along with 12% sugar and 93%, 92% and 90% milk respectively secured the lowest score and was unacceptable to the panelists. On the basis of dry weight moisture, total carbohydrates, fat, protein and ash contents were found as 71.82%, 19.36%, 4.41%, 3.69%, 0.72% respectively for jackfruit yogurt; and 73.20%, 17.7%, 4.67%, 3.73% and 0.70%, for plain yogurt, respectively. The minerals potassium, phosphorus, magnesium and calcium contents were found 284, 110, 19.2 and 131 (mg/100g) for formulated jackfruit yogurt, respectively and 278, 173, 19 and 209 (mg/100g) respectively for plain yogurt. Jackfruit yogurt contain high amount of β carotene of 22.62 (µg/100g) whereas 9.11 (µg/100g) β carotene was found in plain yogurt. The jackfruit yogurt will be very tasteful and nutritive as well as acceptable to consumers when it is prepared by adding 6.5% jackfruit juice and 12% sugar with 93.5% milk.

Key words: Yogurt, Jack Fruit Juice, Milk, Organoleptic Analysis.

Introduction

Jackfruit *(Artocarpusheterophyllus*L.*)* is the national fruit of Bangladesh with very delicious taste and large in size among the fruits grown in Bangladesh. The climatic condition of Bangladesh is also very much suitable for jackfruit production. Due to high nutritional value and taste, it is abundantly grown in homestead almost all of the rural areas of Bangladesh. It ranks at the top position in production among the fruits grown in Bangladesh accounting 23.08 percent of total fruit production (BBS, 2010).But during the peak season (June-July), about 50% of the other fruits like pineapple, jackfruit etc. is spoiled due to the lack of appropriate processing and preservation in Bangladesh (Hussain, 1993).

Jackfruit has been reported to contain high levels of protein, starch, calcium, and thiamine (Burkill, 1997). It also contains Vitamin C that act as an antioxidant and protects the body against free radicals, strengthens the immune system (Umesh*et al.*, 2010). It is also rich source of various phytonutrients such as lignans, isoflavones, and saponins that have health benefits of anticancer, antihypertensive, antiulcer and antiaging properties. The phytonutrients as found in jackfruit can prevent formation of cancer cells in the body and help to decrease the blood pressure, fight against stomach ulcers as well as slow down the degeneration of cells that make the skin look young and vitae. The carotenoids containing Jackfruit play important role for the prevention of several chronic degenerative diseases, such as cancer, inflammation, cardiovascular disease, cataract, age-related macular degeneration (Krinsky*et al.*, 2003; Stahl and Sies, 2005). Jackfruit contains phenolic compounds which acts as an antioxidant and prevent rapid oxidation of milk fat. Another agricultural product which produce in large number and also spoiled huge amount due to lack of proper processing and preservation; is milk. It is very much preferable for balance diet. But a significant amount of milk is disfigure very rapidly due to oxidation of milk fat and cause rancidity. Now a days, various milk products are being introduced in the local market and also worldwide. Among these milk products, yogurt is more favorite food item. Yogurt is a healthy and delicious food due to its

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high nutritive and therapeutic value (Perdigon*et al.*, 2002). Due to low lactose content yogurt is easily digestible and palatable than milk. Yogurt is valued for controlling the growth of harmful bacteria and in curing of intestinal disease like constipation, diarrhea & dysentery, anti-carcinogenic effect and lowering of blood cholesterol (Kamruzzaman*et al.*, 2002). It is generally considered as a safer product and its unique flavor appeals to so many that consideration is being given by nutritionists to incorporate inexpensive source of nutrients to make it an almost complete food (Boghra and Mathur, 2000).

Preparation of fruit yogurt has been investigated by a number of researchers in different parts of world (Desai *et al.*, 1994; Shukla *et al.*, 1987). But in Bangladesh very few research works has been done on the preparation of yogurt incorporating jackfruit juice.

Based on the information as accumulated above the present study has undertaken under the following objectives:

1. To prepare yogurt using jackfruit juice as a partial ingredient
2. To analyze the chemical composition of the developed yogurt
3. To assess the organoleptic properties of the yogurt

Materials and methods

The experiment was conducted in the laboratory of the Department of Agro-Processing, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur and some parts of the analyses were done at the Post-harvest Technology Laboratory of Bangladesh Agriculture Research Institute, Gazipur. Whole milk was collected from the farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur. The jackfruit was purchased from local Joydebpur market in Gazipur. Yogurt purchased from local market used as starter culture. Chemicals, solvents, glassware, refrigerator, oven, muffle furnace, soxhlet apparatus, digestion chamber, distillation unit were used in the study from laboratory stock.

Different eight levels of jackfruit juice were incorporated to prepare different samples of Jackfruit yogurt (JY).Plain yogurt was prepared from fresh milk using a traditional method. After collection, the milk was first heated to 70 ^{0}C for 15 -30 minutes. After that sugar was added and heated to about 80^{0}C until concentrate by reducing of its original volume (one third volume of original milk) with continuous stirring. Clarified jackfruit juice was also added in various proportion. Then the prepared samples were cooled to 42 ^{0}C and inoculated with 1 spoon yogurt and maintained the temperature with the range of 37 -39 ^{0}C for 16 to 18 hours approximately until desired degree of coagulation was achieved. Then it was cooled rapidly to 5-10 ^{0}C. Finally, desired yogurt was formed. Similarly, plain yogurt was prepared with milk and the addition of the mother culture following the same procedure.

Organoleptic Analysis

Various methods have been used to measure food preferences. The most common method is a questionnaire of generated foods or food categories in which a hedonic scale is used to rate the degree of likings. Hedonic scale is an organoleptic quality rating scale where the judge expresses his degree of likings. A 9 point balanced scale was used (Ranganna, 1991). Overall tests were conducted by using nine point Hedonic scales. The general form of the scale: 1. Dislike extremely, 2. Dislike very much, 3. Dislike moderately, 4. Dislike slightly, 5. Neither like nor dislike, 6. Like slightly, 7. Like moderately, 8. Like very much, 9. Like extremely. Appearance, color, flavor, texture, taste and overall acceptance of the samples were accomplished. The 10 panelists were teachers and students of different departments, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. In Hedonic scaling, response, i.e. state of like and dislike are measured on a rating scale. The essential features of the Hedonic scale were its assumption of a continuum of preferences and the direct way it defined the categories of response in terms of like and dislikes.

Statistical analysis

Data collected from the sensory evaluation were analyzed by the use of Analysis of Variance (ANOVA) and mean procedure of Statistical Analysis System (SAS). When the significance differences (at 5% level of significance) were observed. Duncan's Multiple Range Test (DMRT) was used to analyze the differences between the means.

Proximate composition and nutritional analysis of selected jackfruit yogurt sample through organoleptic analysis and plain yogurt were determined according to Rangana (1991), AOAC (1990) and Piper (1966).

Results and Discussion

Organoleptic analysis

In this study, primary thirteen samples were formulated with different percentage of jackfruit juice, milk and sugar. The samples were characterized for sensory evaluation. Among these samples, JY 3 (94% cow

milk + 6% jackfruit juice + 12 % sugar) perform the best results on the basis of color, flavor, texture, taste and overall acceptability. Then for getting more precious formulation, another three samples were used which were JY 16 (93.5% cow milk, 6.5% jackfruit juice and 12 % sugar), JY 17 (93% cow milk, 7% jackfruit juice and 12 % sugar) and JY 18 (92.5% cow milk, 7.5% jackfruit juice and 12 % sugar). For the sensory evaluation only four jackfruit yogurt samples along with plain yogurt sample were selected as samples and the Hedonic Rating test was conducted on each sample.

The DMRT test revealed that sample- PY 1 and sample-JY 16 were equally acceptable in terms of color preference(Table 1) and they did not show significantly different ($p<0.05$). The sample- JY 16 was better than others in terms of color preference and secured the highest color score (7.7) while sample- PY 1, sample-JY 3, sample-JY 17 and sample-JY 18 earned 7.5, 6.9, 5.9 and 5.5 respectively. The mean values of flavor of plain yogurt and jackfruit yogurt samples were 7.20, 6.60, 7.60, 5.9 and 5.8 respectively (Table 1). Statistical analysis showed that significant ($p < 0.05$) difference exists among the flavor acceptability of different samples. The mean value of flavor for jackfruit yogurt (JY 16) did not significantly different ($p<0.05$) from plain yogurt but it scored highest result as compared to Plain yogurt and secured 7.60 and can be ranked as "Like much". The lowest score (5.8) was recorded in JY 18 which did not significantly different along with JY 17. Textures of the curd depend mainly upon the rate of development of the acidity. The mean values of texture of plain yogurt and jackfruit yogurt shown in Table 4.1. From Table 4.1, it was observed that sample- JY 16 is better than others in terms of texture preference and secured the highest score 7.5 while sample- PY 1 and sample-JY 3 earned 7.0 and 7.3, respectively which did not differ significantly. Sample-JY 17 and sample-JY 18 secured the lowest score as 5.9 and 5.5 respectively. As shown in Table 1 the DMRT test revealed that sample- JY 16 is most acceptable in terms of taste acceptability followed by sample – PY 1, sample- JY 3, sample- JY 17 where sample- JY 18 is the least acceptable product. The test also showed that the sample- PY 1 and sample- JY 16 are equally acceptable in terms of taste preference and they were not significantly different ($p<0.005$). Sample- JY 17 and sample- JY 18 did not show significantly different ($p<0.005$) but they secured the lowest scores which was 5.40 and 5.20 respectively and can be ranked as "neither like nor dislike". Among five experimental samples it was found that sample – JY 16 received the highest taste score 7.50 while sample – PY 1and sample- JY 3 scored 7.0 and 6.70 respectively. Thus the sample – JY 16 is significantly different and better than other experimental samples and can be ranked as "Like much". In case of overall acceptability it can be seen from Table 4.1 that sample- JY 16 and sample- PY 1 are equally acceptable securing the highest score (7.20 and 7.0) and are the most acceptable product among the experimental samples while sample- JY 3, sample- JY 17 and sample- JY 18 received overall scores of 6.00, 5.00 and 4.70 respectively. The DMRT test also showed that there is significant difference ($P<0.005$) between sample- JY 3, JY- 17 and JY-18 in terms of overall acceptability and the sample- JY 18 secures the lowest score (4.70) which is unacceptable.

Table 1. Organoleptic evaluation of developed yogurt

Samples	**Sensory attributes**				
	Color	Flavor	Texture	Taste	Overall acceptability
PY 1	7.5^{ab}	7.2^{ab}	7.0^{ab}	7.0^{ab}	7.0^{a}
JY 3	6.9^{b}	6.6^{c}	7.3^{ab}	6.7^{b}	6.0^{b}
JY 16	7.7^{a}	7.6^{a}	7.5^{a}	7.5^{a}	7.2^{a}
JY 17	5.9^{c}	5.9^{c}	5.8^{c}	5.4^{c}	5.0^{c}
JY 18	5.5^{c}	5.8^{c}	5.6^{c}	5.2^{c}	4.7^{c}

Means with same superscript within a column are not significantly different at $p<0.05$

PY 1 = 100% cow milk+ 10% sugar

JY 3 =94% cow milk + 6% jackfruit juice + 12 % sugar

JY 16 =93.5% cow milk + 6.5% jackfruit juice + 12 % sugar

JY 17 =93% cow milk + 7% jackfruit juice + 12 % sugar

JY 18 =92.5% cow milk + 7.5% jackfruit juice + 12 % sugar

Composition of plain and formulated jackfruit yogurt

The formulated jackfruit yogurt (JY) obtained by the sensory evaluation of different samples were prepared and analyzed for their composition with the plain yogurt (PY). The results are shown in Table 2.

Table 2. Composition of plain yogurt and formulated jackfruit yogurt

Chemical composition	PY	JY
% Moisture	73.20	71.82
% Total soluble solids	26.80	28.17
% Carbohydrate	17.7	19.36
% Fat	4.67	4.41
% Protein	3.73	3.69
% Ash	0.70	0.72
Vitamins and Minerals		
β carotene (µg/100g)	9.11	22.62
Phosphorus (mg/100g)	173	110
Potassium (mg/100g)	278	284
Magnesium (mg/100g)	19	19.2
Calcium (mg/100g)	209	131

PY = 100% cow milk + 12% sugar

JY = 93.5% cow milk + 6.5% jackfruit juice + 12 % sugar

The total solids content of plain and jackfruit yogurt were 26.80 and 28.17 percentage respectively (Table 2). The total solids content of jackfruit yogurt increased with the addition of jackfruit juice which was also observed by Desai *et al.* (1994) who found that total solids contents increased significantly through the addition of fruit juice. This might be due to the addition of Jackfruit juice with more total solids than milk. The same results were reached by Rahman (1998). Mustafa (1997) also conducted an experiment with different types of fruit juice and found that juice addition significantly increased the total solids content of Dahi. Ghosh and Rajorhia (1987) observed that the total solids content of plain market Dahi varied from 26.92 % to 43.04 % with an average value of 34.64 % which is similar to the present results. Kamruzzaman*et al.* (2003) reported that plain Dahi contained a lower amount of total solids compared to fruit Dahi. The average values for fat content of plain yogurt and jackfruit yogurt were 4.67% and 4.41% (Table 2) which supported by the Rashid and Miyamoto (2005) findings that the fat content of plain yogurt was 4.31-4.88%. The fat contents of the jackfruit yogurt was lower than the plain yogurt which also similar to the observations founded by Desai *et al.* (1994). Similar results were obtained by Rahman (1998) and Mustafa (1997). As fruit contains low level of fat. So the addition of fruit juice might have decreased the fat percent of fruit dahi. Moreover, Ara *et al.* (2010) observed the fat content of plain yogurt depends on the composition of milk. Yonus*et al.* (2002) reported a fat content of plain yogurt within the range of 0.96 % to 4.3 % whether the fat content of plain yogurt and jackfruit yogurt was 4.67% and 4.41% respectively as similar to the range of fat content reported by Yonus*et al.* (2002).The average values of protein content of plain yogurt was highest (3.73%) compared to fruit yogurt (3.69%) shown in Table 2 which is agreed with the observation of Mustafa (1997). Similar type of result was also obtained by Desai *et al.* (1994). The protein content was higher in plain yogurt than jackfruit yogurt. Probably due to adding fruit juice because fruit juice contains lower protein than milk.The ash content of plain yogurt and jackfruit yogurt were 0.70% and 0.72% respectively (Table 2). The ash content of jackfruit yogurt was higher than the ash content of plain yogurt which was also similar in the observation of Mustafa (1997) and Desai *et al.* (1994) who found that addition of fruit juice decrease the ash percentage in yogurt.β carotene is a very important element which is the pre-cursor of Vit-A present at very high amount in Jackfruit juice formulated yogurt. The presence of β carotene (22.62 µg/100g) was much more higher in the jackfruit yogurt as compared to plain yogurt (9.11 µg/100g) (Table 2) which is similar to the finding of McCance and Widdowson's (2002) who found that the carotene content of the fruit yogurt is around 21%. Among all the minerals analyzed, magnesium content of both plain yogurt and jackfruit yogurt was 19.00 and 19.2 mg/100g respectively (Table2) which was almost similar. Potassium content in the Jackfruit yogurt (284 mg/100g) was higher as compared to plain yogurt (278 mg/100g) (Table 2). The potassium content observed in jackfruit yogurt showed higher result than the plain yogurt as jackfruit juice contains high percentage of potassium than plain yogurt which is similar with the findings of McCance and Widdowson's (2002). Phosphorus is an important mineral as it is constituent of the nucleic acids, nucleotides, phospholipids and techoic acids. Phosphorous content of the plain yogurt and jackfruit yogurt were 173.00 mg/100g and 110.00 mg/100g, respectively (Table 2).

Calcium content in Plain yogurt was higher as compared with the jackfruit yogurt. The values of calcium content of jackfruit and plain yogurt were 109 mg/100g and 131mg/ 100g. The increment of calcium content in plain yogurt might be attributed by the presence of jackfruit juice where the calcium content of the juice was significantly lower compared to the calcium content of the milk.

Conclusion

Judging from the different parameters studied from the experiment it may be concluded that 6.5% of jackfruit juice could be used to prepare jackfruit yogurt with 93.5% milk. If the yogurt formulated with addition of 6.5% jackfruit juice and 93.5% milk and 12% sugar will be the most tasteful, acceptable and nutritive one. Addition of jackfruit juice not only makes the product different, but also it makes the less use of milk in yogurt production. Thus productions of maximum volume of yogurt from minimum volume of milk by incorporating jackfruit juice might popularize the milk products.These new dairy products might benefit elderly consumers by reducing the risk of blood cholesterol, and would also make use of seasonal surplus fruits and therefore profit to farmers.

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