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Physico-chemical study of fresh jamun (*Syzygium cumini* L.) yoghurt

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Abstract
The present investigation entitled "Process Standardization and Quality Evaluation of Jamun (*Syzygium cumini* L.) Yoghurt" was undertaken during year 2014-15 with a view to standardize the process for preparation of jamun yoghurt with improved therapeutic value using jamun juice and aspartame. Initially, preliminary trials were conducted to finalize the levels of jamun juice and aspartame in the yoghurt. Yoghurt samples were prepared with 3, 6, 9, 12, 15 and 18 percent jamun juice and 0.025, 0.035, 0.045 and 0.055 per cent aspartame. The average chemical composition of fresh yoghurt samples prepared under different treatment combinations ranged from 3.17 to 3.52% fat, 4.08 to 4.55% protein, 14.99 to 15.53% total solids, 0.79 to 0.88% L.A. acidity, 6.68 to 6.94% reducing sugar, 6.68 to 7.04% total sugar, 0.76 to 0.78% ash and pH 4.55 to 4.62.

Keywords: Yoghurt, Jamun, fat, protein, total solids, acidity, PH, reducing sugar, total sugar, ash

Introduction
Yoghurt is a typical fermented milk product consumed all around the world. This biotechnological food is considered by nutritionists as having high nutritional value and positive bioactive effects. The natural plain yoghurt is produced by adding lactic acid bacteria, a pure culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* (1:1) ratio that causes the lactic fermentation. Among all fermented milk products, yoghurt is well known than others and has more acceptability in the world (Coisson *et al.*, 2005) [4].

Yoghurt's nutritional profile has a similar composition to the milk from which it is made but will vary somewhat if fruit, cereal or other components are added. Yoghurt is an excellent source of protein, calcium, phosphorus, riboflavin (vitamin B2), thiamin (vitamin B1) and Vitamin B12 and a valuable source of folate, niacin, magnesium and zinc. The protein it provides is of high biological value and the vitamins and minerals found in milk and dairy foods including yoghurt are bioavailable. Yoghurt particularly the low-fat varieties, provide an array of important nutrients in significant amounts in relation to their energy and fat content, making them a nutrient-dense food. Eating dairy products, such as yoghurt, helps to improve the overall quality of the diet and increases the chances of achieving nutritional recommendations (Arslan and Bayrakci, 2016) [1].

Jamun *(Syzygium cumini)* is a medicinal plant, whose parts were pharmacologically proved to possess hypoglycemic, antibacterial, anti-HIV activity, anti-diarrhea effects and anti-inflammatory activity. According to Ayurveda, its bark is good for sore throat, bronchitis, asthma, thirst, dysentery, blood impurities and to cure ulcers. Vinegar prepared from the juice of the ripe fruit is an agreeable stomachic and carminative and used as diuretic and it is also useful in spleen enlargement and an efficient astringent in chronic diarrhea (Bhatacharjee, 2004).

Jamun fruit extract showed antimicrobial and cytotoxic activities and may potentially be used on topical antimicrobial products. In comparison to other non-traditional fruits jamun showed considerable high antioxidant activity, which contain constituent such as anthocyanins, tannins and flavonoids. The anthocyanin composition was characterized by the presence of 3, 5-diglucosides of five out of six aglycones commonly found in foods. Fruits contain many different kinds of anti-oxidant compounds, including flavonoids, phenolics, carotenoids and vitamins, which are all considered beneficial to human health, for decreasing the risk of degenerative diseases by reduction of oxidative stress and for the inhibition of macromolecular oxidation (Adelia *et al.*, 2011) [2].

Materials and Methods

Preparation of Jamun Yoghurt

The Yoghurt was prepared by using the procedure prescribed by Sharma and Singh (1981) with some minor modifications. Fresh good quality cow milk (3.5 % fat) was taken and added skim milk powder @ 4% subjected to filtration/clarification. The mix was pre-heated to 60°C and homogenized single stage at 2000-2500 psi, the milk was heated to 85°C for 30 min and then cooled to 43 ± 1^0C, aspartame was added. It was then inoculated @ 2% with *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (1:1 ratio) which were mixed well and incubated at 43 ± 1^0C for 5 hours in plastic cups/containers. When the curd has set firmly, it is transferred in refrigerator and stored at 5 ± 2^0C.

Physical property analysis

Fat: As per the method described in IS: 1244, Part I, 1977. Protein: As per the procedure described in IS: 1479 (part-II) (1961).Lactose: As per Lane and Eynon method given in IS: 1479, Part II (1961).Total solids: As per the method given in IS: 1479 Part-II(1961).Titratable acidity (% L. A.) As per the method given in IS: 1479, Part –I(1960).pH:As per the method given in IS: 1479, Part –II(1961).Total soluble solids: The total soluble solids in the juice was determined with the help of Erma hand refractometer (Range 0-32^0 Brix) pH:pH of the jamun juice was measured by Elico digital pH meter. Reducing sugar and total sugar: Reducing sugar and total sugar was determined by the method of Lane and Eynon (1923) [16], as adopted by Ranganna (1986) [22]. Acidity: Acidity of the juice samples was determined as per method described by Ranganna (1986) [22]. Ascorbic acid: Ascorbic acid content in the juice samples was determined by using 2-6 dichloro phenol indophenol dye (Johnson, 1984) as per the method reported by Ranganna (1986) [22].

Statistical Analysis

The data generated during the course of this investigation was tabulated and analyzed using Completely Randomized Design (CRD) for pre-experimental trials and to compare control with other treatments. However, effect of jamun juice and aspartame levels and their interaction effect was analyzed by Factorial Completely Randomized Design (FCRD) with three replications (Snedecor and Corchan, 1994) [24].

Result and Discussion

Fat

It was revealed that, the fat content of fresh yoghurt samples significantly (P<0.05) influenced due to different treatment combinations. The fat content under different treatments ranged from 3.17 to 3.52 per cent (Table1). Treatment T_0 (control) had maximum fat per cent i.e. 3.52 followed by T_1, T_2, T_3, T_4, T_5 and T_6. However, treatments T_1 and T_2, T_3 and T_4, T_5 and T_6 were at par with each other. The fat content of yoghurt samples was significantly (P<0.05) reduced due to addition of jamun juice. As the jamun juice level increased the fat content of yoghurt samples decreased significantly. This decrease in fat content might be due to very low fat content of jamun juice. The results are in agreement with the findings of Desai *et al.,* (1995) [6], Cinbas and Yazici (2008) and Kale *et al.,* (2008) [5, 7]. They reported that the fat content decreased with increased fruit level as a result of less fat content of fruits as compare to milk.

Protein

Table 1 it was revealed that, different treatment combinations had significant (P<0.05) effect on the protein content of fresh yoghurt samples. The protein content under different treatments ranged from 4.08 to 4.55 per cent. Treatment T_0 (control) had significantly higher protein content i.e. 4.55 per cent than the rest of treatment combinations. However, treatments T_1 and T_2, T_3 and T_4, T_5 and T_6 were at par with each other. The protein content of yoghurt was significantly (P<0.05) influenced by the addition of jamun juice. As the jamun juice level increased the protein content of yoghurt decreased significantly, this decrease might be attributed to lower protein content in jamun juice as compared to milk.
Farahat and Batawy (2013) [8] prepared stirred yoghurt with different fruit homogenates and reported that protein content of fruit yoghurt declined as the level of fruit increased in yoghurt preparation.

Total Solids

It was revealed that the mean total solids content of fresh yoghurt samples ranged from 14.99 (J_3A_1) to 15.53 (control) per cent (Table 4.20 and Fig. 9). All treatments significantly (P<0.05) differed from each other. Treatment T_0 (control) had higher total solids content (15.53 %) than rest of treatment combinations under study. However, treatments T_1 and T_2, T_3 and T_4, T_5 and T_6 were at par with each other. The total solids content of yoghurt was significantly (P<0.05) influenced due to addition of jamun juice. As the jamun juice level increased the total solids content of yoghurt significantly decreased. It might be due to lower total solids content of juice than milk used. The results are in agreement with the results of Tarakci and Kucukoner (2003) and Roy *et al.,* (2015) [25, 23].

Acidity

It was revealed that, all treatments had significant (P< 0.05) effect on the acidity of fresh yoghurt samples. Acidity of yoghurt samples was ranged from 0.79 to 0.88 per cent L.A. (Table 4.22 and Fig. 10). Treatment T_5 (J_3A_1) had maximum acidity per cent followed by T_6, T_3, T_4, T_1 and T_2. However, treatments T_0, T_1 and T_2, T_3, T_4 and T_6 were at par with each other. Acidity increased with increasing levels of jamun juice, it might be due to more acidity of jamun juice. Desai *et al.,* (1994) reported that, fruit juice initiates quick fermentation in yoghurt and acidity of yoghurt increased due to addition of fruit juice. The results are in agreement with the findings of Rahman *et al.* (2001), Kauser *et al.* (2011), Hossain *et al.* (2012) and Roy *et al.* (2015) [21, 15, 9, 23].

PH

It was revealed that, all treatment combinations had significant (P<0.05) effect on the pH of fresh yoghurt samples. It was observed that, the mean pH of yoghurt samples ranged from 4.55 to 4.62 (Table 1). Treatment T_0 (control) had higher pH value and treatment T_5 had the lowest pH value. However, treatments T_0, T_1 and T_2, T_3, T_4 and T_6 were at par with each other. The pH decreased with increasing levels of jamun juice it might be due to increased acidity with increasing juice level in yoghurt preparation. Mahmood *et al.* (2008) [17] and Kauser *et al.* (2011) [15] reported decrease in pH with increasing level of fruit pulp.

Reducing sugar

It was revealed that, all treatments had significant (P<0.05) effect on the reducing sugar content of fresh yoghurt samples. Reducing sugar content of fresh yoghurt samples ranged from 6.68 to 6.94 per cent. Treatment T_6 (J_3A_2) had maximum reducing sugar per cent (6.94) and treatment T_0 had lowest

reducing sugar content (6.68). However, treatments T_1 and T_2, T_3 and T_4, T_5 and T_6 were at par with each other. Reducing sugar content increased with increasing level of jamun juice, it might be due to juice contains more amount of reducing sugar than milk. These findings were in accordance with the results of Mbaeyi-Nwoha and Ekere (2014) and Matter *et al.* (2016) [18].

Total Sugar

From Table 1, it was revealed that, all treatment combinations had significant (P<0.05) effect on the total sugar content of fresh yoghurt samples. Total sugar content of fresh yoghurt samples ranged from 6.68 to 7.04 per cent. Treatment T_6 (J_3A_2) had higher total sugar (7.04 %) and treatment T_0 had lowest total sugar content (6.68 %). However, treatments T_1 and T_2, T_3 and T_4, T_5 and T_6 were at par with each other. Total sugar content increased with increasing level of jamun juice, it might be due to the sugar content in the juice. The total sugar content in fresh yoghurt samples under this investigation was comparable with findings of Mahmood *et al.* (2008) [17], Yousef *et al.* (2013) [26] and Pagthinathan *et al.* (2016) [20]. They reported that, there is increase in total sugar content with increasing fruit level as fruit pulp/ juice contained higher amount of total sugar than milk.

Ash

It was revealed that, all treatments had non significant (P > 0.05) effect on ash content of fresh yoghurt samples. Ash content of fresh yoghurt samples was ranged from 0.76 to 0.78 per cent. Treatment T_0 (control) had higher ash per cent and ash content slightly decreased as increased juice level. Rahman *et al.*, (2001) [21] and Mabaeyi- Nwaoha and Ekere (2014) also investigated that, there was decrease in ash content with increasing Soursop pulp, but decrease was non significant.

Table 1: Chemical composition of fresh Jamun Yoghurt

Treatments	Mean Score							
	Fat (%)	Protein (%)	Total solids (%)	Acidity (% L.A.)	pH	Reducing sugar (%)	Total sugar (%)	Ash (%)
T_0 (J_0A_0)	3.52^{d}	4.55^{d}	15.53^{d}	0.79^{a}	4.62^{b}	6.68^{a}	6.68^{a}	0.78
T_1 (J_1A_1)	3.37^{c}	4.37^{c}	15.35^{c}	0.83^{abc}	4.59^{ab}	6.80^{b}	6.86^{b}	0.77
T_2 (J_1A_2)	3.35^{c}	4.38^{c}	15.38^{c}	0.82^{ab}	4.61^{b}	6.82^{bc}	6.88^{b}	0.77
T_3 (J_2A_1)	3.29^{b}	4.25^{b}	15.19^{b}	0.86^{bc}	4.57^{ab}	6.86^{cd}	6.94^{c}	0.77
T_4 (J_2A_2)	3.27^{b}	4.26^{b}	15.22^{b}	0.85^{bc}	4.59^{ab}	6.88^{de}	6.96^{c}	0.77
T_5 (J_3A_1)	3.19^{a}	4.08^{a}	14.99^{a}	0.88^{c}	4.55^{a}	6.92^{ef}	7.02^{d}	0.76
T_6 (J_3A_2)	3.17^{a}	4.09^{a}	15.02^{a}	0.87^{bc}	4.58^{ab}	6.94^{f}	7.04^{d}	0.76
SE ±	0.019	0.025	0.024	0.016	0.014	0.016	0.013	0.008
CD at 5%	0.058	0.075	0.073	0.050	0.042	0.048	0.038	NS

Conclusion

The average chemical composition of fresh yoghurt samples prepared under different treatment combinations ranged from 3.17 to 3.52 per cent fat, 4.08 to 4.55 per cent protein, 14.99 to 15.53 per cent total solids, 0.79 to 0.88 per cent L.A. acidity, 6.68 to 6.94 per cent reducing sugar, 6.68 to 7.04 per cent total sugar, 0.76 to 0.78 per cent ash and pH 4.55 to 4.62. It was seen that, jamun juice levels had significant (P<0.05) effect, aspartame levels had non significant effect and the interaction effect of juice and aspartame levels was also non significant on all chemical characteristics of fresh yoghurt samples.

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