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Production and Evaluation of Yoghurt Ice Cream

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Abstract: Yoghurt ice cream was prepared from buffalo milk using conventional ice cream-making technique. A total of three trials (six batches in each) were conducted and analyzed for chemical characteristics and sensory attributes. Total Solids (TS) content of yoghurt ice cream averaged 32.79±0.64%, protein content 5.18±0.16%, fat content 4.84±0.10% and ash content 1.06±0.08%. The overall mean score rated by panelists for appearance/color was 3.68±0.08, for taste/flavor 39.63±0.71, for body/texture 25.50±0.42 and for melting quality 3.56±0.13 from a total score of 5, 45, 30 and 5, respectively. The overall average meltdown rate of yoghurt ice cream for 10 min was 15.76±1.48%, for 20 min 40.49±2.03%, for 30 min 65.72±1.95%, for 40 min 83.12±1.42% and for 50 min 93.19±1.26%. Sensory characteristics of yoghurt ice cream were gradually improved after 1 month and 3 months storage period and perceived the better score among sensory space map. Stored (3 months) yoghurt ice cream comparatively perceived the highest score for appearance/color (4.45±0.08), taste/flavor (44.11±0.18), body/texture (28.78±0.16) and melting quality (4.61±0.13) followed by one month stored (4.38±0.10, 43.67±0.22, 28.00±0.28 and 4.55±0.14, respectively) and fresh yoghurt ice cream (3.68±0.08, 39.63±0.71, 25.55±0.42 and 3.56±0.13, respectively) from a total score of 5, 45, 30 and 5, respectively. Sensory properties of yoghurt ice cream discriminated the product with attractable appearance/color, acceptable/palatable flavor and better body/texture.

Key words: Yoghurt ice-cream, production, evaluation, storage

INTRODUCTION

Ice cream is a palatable and highly nutritious food, prepared from the buffalo and cow milk or combination of the both, the other ingredients are cane sugar, dextrose, fruit juices, preserved fruit, nuts, chocolate, edible flavor and permitted food colors. Ice cream production is rapidly developing technology that has become a profitable industry because of recent advances. Diverse ingredients and methods of freezing have resulted in 240 different types of ice cream (Guven and Karaca, 2002). Many under-nourished individuals are deficient in lactase and cannot tolerate appreciable quantities of milk or milk solids. Many who suffer lactose intolerance mistakenly believe that they must avoid all dairy products. The conversion of milk to yoghurt should make it possible for these groups to consume appreciable quantities of milk with minimal symptoms of lactose intolerance due to reduction in lactose (approximately 30%) during fermentation (Chandan and Shahani, 1993). Yoghurt is an excellent food that is easy to digest and is of high biological value and is known to lower cholesterol levels (Guven and Karaca, 2002). The use of yoghurt instead of milk decreased the viscosity of ice cream mix and over-run capacity of ice cream (Guner *et al*., 2007). However, mixing ice-cream mix and yoghurt offers sensory and physical properties that are similar to those of ice cream and yoghurt (EL-Nagar *et al*., 2002). No scientific work has been done in any aspects on yoghurt ice cream in Pakistan, thus aim of present study was to produce and evaluate the quality characteristics of yoghurt ice cream.

MATERIALS AND METHODS

A total of three trials (six batches in each) were conducted to produce yoghurt ice cream from buffalo milk using conventional ice cream-making technique at the Department of Animal Products Technology. Buffalo milk procured from Livestock Experiment Station, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, was used during the experimental trials.

Preparation of starter culture: Artisan starter culture was prepared by fermenting the buffalo milk with natural yoghurt culture and purified by re-culturing it several times. The purified culture was maintained during the experimental period.

Preparation of yoghurt: Milk was pasteurized (90°C) for 5 min and cooled to 45±1°C using running tap water. Afterwards, it was inoculated with 2.5% artisan yoghurt starter culture and incubated at 40±1°C (~3 hrs) till pH of milk base decreased to 4.7.

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Preparation of ice mix: Ice cream mix was prepared as described by Guner *et al.* (2007). It was formulated as: 15% sugar and 0.1% gelatin added with whole buffalo milk (70% of total amount of ice cream mix). The mixture was heated (90°C) for 5 min and then cooled to 45±1°C. Shortly after the yoghurt reached at desired level of pH, it (30% of total amount of ice cream mix) was mixed with ice cream blend.

Freezing of yoghurt ice-cream mix: Ice-cream mix was transferred to conventional electrical ice-cream machine and frozen for~20 min. The frozen yoghurt ice-cream was transferred to a freezer (-18±2°C) for hardening and subsequently it was stored till further analysis.

Analysis: Total solids, protein, fat and ash contents of yoghurt ice-cream were analyzed according to methods as described by Association of Official Analytical Chemists (AOAC, 2000).

Sensory quality of yoghurt ice-cream (fresh and stored): Sensory attributes of yoghurt ice-cream (fresh and stored) were evaluated according the scheme of Nelson and Trout (1981). The sensory panel comprising of 6 judges were selected and they were first experienced with various sensory attributes like appearance/color, flavor, body/texture and melting quality of the product i.e. (yoghurt ice-cream) and thereafter samples were served to rate the score.

Meltdown rate: Meltdown rate was determined according to the method of Guner *et al.* (2007). Yoghurt ice-cream (100 g) after freezing at-18±2°C was placed on a wire filter and fixed onto a beaker (24°C). The weight of melted material was measured at 10th, 20th, 30th, 40th and 50th min and expressed as percentage weight melted.

RESULTS AND DISCUSSION

In the present study some preliminary trials were performed to produce yoghurt ice cream from buffalo milk and yoghurt as a basic ingredient for the mix with ratio of 1:3, 1:1, 3:1 and 2:1, respectively. Some difficulties were experienced during initial trials. However, it was successfully produced as acceptable product from mix containing 70% buffalo milk and 30% yoghurt with addition of 15% sugar and 0.1% gelatin. Similar studies were conducted by El-Nagar *et al.* (2002), who produced ice-cream from stirred yoghurt blended with ice-cream pre-mix (1:1) and frozen in a batch-top ice cream maker, whereas, Caisip and Resubal (2001) and Jaswinder *et al.* (2006) prepared yoghurt ice cream by direct inoculation of aged ice-cream mix with starter culture prior to freezing. While Guner *et al.* (2007) produced it from mix blended with 74.3% yoghurt.

Table 1: Chemical characteristics (%) of yoghurt ice cream

	Descriptive measures			
Characteristics	Min.	Max.	Mean	±SE
Total solids content (%)	30.17	38.41	32.79	0.64
Protein content (%)	4.46	6.25	5.18	0.16
Fat content (%)	4.00	5.40	4.84	0.10
Ash content (%)	0.79	2.29	1.06	0.08

Min. = Minimum; Max. = Maximum

Chemical characteristics: Results shown in Table 1 revealed that total Solids Content (TS) of yoghurt ice-cream was in between 30.17 and 38.41% and averaged in concentration of 32.79±0.64%. The result of the present study is consistent with the findings of El-Owni and Zeinab (2009), who observed relatively the similar TS content of ice cream i.e. in between 31.82 to 33.41%. However, Jaswinder *et al.* (2006) found a significant decrease in TS content of ice cream mix when yoghurt base was added to it.

Protein content of yoghurt ice cream was found to be in a range between 4.46 and 6.25% with the mean value of 5.18±0.16% (Table 1). The present findings are not in agreement with the results of Emata *et al.* (2001) who reported 3.72% protein content in low fat yoghurt ice cream. Similarly, the results of present investigation are also higher than the findings of El-Owni and Zeinab (2009) who reported the range of protein content in between 2.49 and 2.69%. It is of interest to note that in the present study, the concentration of protein in yoghurt ice cream was remarkably higher than that of observed by the different researchers (Emata *et al.*, 2001; El-Owni and Zeinab, 2009). This could have been attributed with the formulation of ice cream mix in which buffalo milk was used as dairy base for the mix and assumed to contain higher percentage of protein.

The fat content of yoghurt ice cream was in between 4.00 and 5.40% with an average of 4.85±0.10% (Table 1). The result of present study was not in agreement with findings of Inoue *et al.* (1998) who reported >8.0% fat content in ice cream type frozen yoghurt. However, it was relatively similar in fat content to that of light class (5% fat) vanilla ice cream produced by Aimee *et al.* (2001).

The ash content of yoghurt ice cream was observed in between 0.79 and 2.29% with an average of 1.06±0.08%. These results are not in consistent with the findings of other reported work i.e. in between 0.39 to 0.64% (El-Owni and Zeinab, 2009).

Sensory evaluation: Yoghurt ice cream was evaluated by panel of judges for sensory attributes like appearance/color, flavor, body/texture and melting quality. The score rated was in a range of 3.00 to 4.50 (mean, 3.68±0.08), 32.00 to 43.00 (mean, 39.63±0.71), 21.5 to 28.50 (mean, 25.50±0.42) and 2.50 to 4.50 (mean, 3.56± 0.13) among a total score of 5, 45, 30 and

Table 2: Sensory evaluation (score) of yoghurt ice cream

	Descriptive measures			
Sensory attributes	Min.	Max.	Mean	±SE
Appearance/color (Max. Score 5)	3.00	4.50	3.68	0.08
Taste/flavor (Max. Score 45)	32.00	43.00	39.63	0.71
Body/texture (Max. Score 30)	21.50	28.50	25.50	0.42
Melting quality (Max. Score 5)	2.50	4.50	3.56	0.13

Min. = Minimum; Max. = Maximum

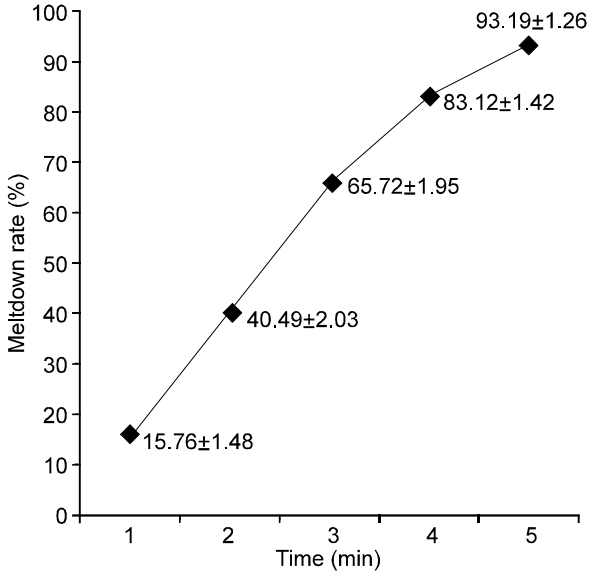

Fig. 1: Trend of meltdown rate (%) of yoghurt ice cream

5 for appearance/color, flavor, body/texture and melting quality, respectively. It was observed that there was no remarkable effect of yoghurt on the above said sensory attributes of the final product. Similar results of sensory scores of yoghurt ice cream produced from the yoghurt at 0.7% lactic acid were observed when compared with the control group (Guner *et al*., 2007). While the score of sensory attributes of flavor, body and texture and overall acceptability differed significantly in yoghurt ice cream prepared with yoghurt organisms (1:1) using (a) blending yoghurt (15-60%) with ice cream mix prior to freezing and (b) by direct inoculation of aged ice cream mix with yoghurt culture (2-4%) followed by incubation prior to freezing (Jaswinder *et al*., 2006). In another study no "acidic-yoghurt taste" was observed in yoghurt ice cream (Caisip and Resubal, 2001). Emata *et al*. (2001) given the preference to yoghurt ice cream with one hour and thirty minutes incubation period and rating scores were like moderately to like very much in terms of the flavor, aroma, color and appearance, body and texture and general acceptability.

Meltdown rate: On an average, 93.19% of yoghurt ice cream samples were melted within a time of 50 min (Fig. 1). Whereas, Dogruer *et al*. (2004) reported that the

Table 3: Sensory quality (score) of fresh and stored yoghurt ice cream

	Sensory attributes			
Storage period	A/C	T/F	B/T	MQ
Fresh	3.68±0.08^{b}	39.63±0.71^{b}	25.55±0.42^{b}	3.56±0.13^{b}
1 month	4.38±0.10^{a}	43.67±0.22^{a}	28.00±0.28^{a}	4.55±0.14^{a}
3 month	4.45±0.08^{a}	44.11±0.18^{a}	28.78±0.16^{a}	4.61±0.13^{a}
±SE	0.18	0.52	0.61	0.20
LSD (0.05)	0.38	1.07	1.26	0.41

Means followed by different letters (a,b) within same column are significantly different from one another, A/C = Appearance/color (Max. Score 5), T/F = Taste/flavour (Max. Score 45), B/T = Body/texture (Max. Score 30), MQ = Melting quality (Max. Score 5)

complete melting time of ice cream was in between 38.41 to 40.71 min. Guner *et al*. (2007) reported that there was no negative effect of yoghurt on the melting characteristics of ice cream. The use of yoghurt at 0.7% lactic acid exhibited a good first drop (beginning of the melting point) and melting time, but it was not statistically significant. While Guven and Karaca (2002) reported that there was an increase in the first dripping time period and complete melting times decreased in parallel with the increase in sugar content and fruit concentration of ice cream produced from yoghurt. El-Nagar *et al*. (2002) found a clear relationship between increased oligosaccharide levels and improved melting properties of yoghurt ice cream. While Muse and Hartel (2004) reported the effect of fat destabilization, ice crystal size and consistency coefficient of mix melting rate of ice cream.

Storage quality: The storage quality of yoghurt ice cream was evaluated as difference of sensory scores among the fresh, 1 month and 3 months stored samples. The fresh yoghurt ice cream perceived the score with average of 3.68±0.08, 39.63±0.71, 25.55±0.42 and 3.56±0.13 for appearance/color, flavor, body/texture and melting quality, respectively and after one month period of time, the score significantly ($P<0.05$) increased to 4.38±0.10, 43.67±0.22, 28.00±0.28 and 4.55±0.14, respectively; whereas after 3 months of storage the average score was 4.45±0.08, 44.11±0.18, 28.78±0.16 and 4.61±0.13, respectively. Similarly Jaswinder *et al*. (2006) reported that yoghurt ice cream prepared by blending of yoghurt (15-60%) with ice cream mix prior to freezing and/or by direct inoculation of aged ice cream mix with yoghurt culture (2-4%) followed by incubation prior to freezing, was acceptable up to 40 days of storage at -18±3°C. Inoue *et al*. (1998) reported that no appreciable change in the structure, acidity and pH values of ice cream type frozen yoghurt stored for six months at -35°C.

Conclusion: On the basis of chemical characteristics particularly the fat content (~5%), the yoghurt ice cream was found to be as light ice-cream. While sensory properties discriminated the product with attractable

appearance/color, palatable taste/flavor and better body/texture. Meltdown rate was moderate. Storage (up to 3 months) quality was gradually improved and perceived the better score among sensory space map.

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