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Development of a Frozen Yoghurt Dessert of Sensory Acceptability

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ABSTRACT. A technological process for production of a novel frozen yoghurt by utilizing whey solids in place of skim milk powder was developed. Frozen yoghurt prepared with whey solids had a overrun of 77%, a melting time of 5.4 min, titratable acidity of 0.92% and a starter count of 7.2 × 10^8 cells per g with a sensory scores of 6.8 out of 9.0. To further enhance the sensory score, the yoghurt containing whey solids was blended with ice cream mix in different ratios ranging from 10 : 90 to 50 : 50 and frozen. The blend containing 40 : 60 of yoghurt and ice cream mix gave the highest sensory score (8.5 out of 9.0). This blend also had an overrun of 78%, a melting time of 8.2 min, and titratable acidity of 0.75%. On holding the blend at -20°C for up to 10 days there was a marginal decrease in the viable count to 1.16 × 10^8 cells per g from the initial count of 4.3 × 10^8 cells per g. The frozen yoghurt dessert had all the good attributes including large numbers of viable lactic acid bacteria.

INTRODUCTION

Yoghurt, a fermented milk product, is well known for its nutritional and therapeutic properties because of the presence of large numbers of viable lactic acid bacteria (Renner, 1986). These properties could be further enhanced by the incorporation of whey solids (Mehanna and Gonc, 1988). Yoghurt customarily contains a large number of viable cells from the luxuriant growth of starter cultures, and the viability of these cells is generally affected by improper storage of the product at vendors. Therefore there is a need to develop a yoghurt which can retain the viability of cultures on prolonged storage. In this direction frozen yoghurt is considered as ideal since it not only enhances the viability of the cultures but also the taste of the product by virtue of being close to ice cream which is consumed by a large section of the population. In this investigation an attempt has been made to standardize a method for the preparation of yoghurt with whey solids in place of skim milk powder and to blend such yoghurt with ice cream mix, before freezing, to get a frozen yoghurt dessert having high viable cell count, desired acidity and excellent sensory attributes.

MATERIALS AND METHODS

Yoghurt preparation

Fresh milk samples collected from university cow-herd was used for the preparation of yoghurt. Yoghurt mix was standardized to contain 5.0% fat, 12.5% milk solids-not-fat by using whole milk, cream and skim milk powder. Gelatin at the rate of 0.5% was added as a stabilizer and sugar at the rate of 8% was added to the mix. The standardized yoghurt mix was transferred to sterile conical flasks, heated to 90°C for 10 min and cooled to 43°C. A mixed yoghurt culture consisting of standard strains of *Streptococcus salivarius* sp. thermophilus and *Lactobacillus delbrueckeii* sp. bulgaricus was used at the rate of 2.0% (v/v). The inoculated mix was incubated at 42°C for up to 4 hours until a titratable acidity of 0.7% was developed. The coagulated product was rapidly cooled to 10°C.

A similar procedure was followed for the preparation of modified yoghurt where whey powder was used in place of skim milk powder. Both conventional yoghurt and modified yoghurt were frozen in an ice cream freezer and held overnight at -20°C for hardening.

Ice-cream mix preparation

Ice cream mix containing 10% fat, 11% milk solids-not-fat, 15% sugar, 0.5% stabilizer was prepared, heated to 68°C for 30 min. and rapidly cooled to 10°C (ISI, 1964).

Blends of yoghurt and ice cream mix

Freshly prepared modified yoghurt and ice cream mix were blended in different proportions ranging from 10:90 to 50:50. These blends were then frozen in an ice cream freezer and held overnight at -20°C for hardening.

Analysis

Frozen yoghurts and blends were analyzed for titratable acidity (ISI, 1964), viable starter counts using standard methods agar (APHA, 1978), overrun and melting time (Venkateshaiah, 1995), and overall acceptability by a panel of five trained judges using 9 point hedonic scales. The data were then subjected to Standard Error of Mean (SEM), Critical Difference (CD) and Coefficient of Variation (CV) to test the differences between treatments (Sunderraj *et al.*, 1972).

RESULTS AND DISCUSSION

Conventional yoghurt prepared by using skim milk powder and modified yoghurt prepared using whey powder were frozen, and the characteristics of the frozen yoghurts are shown in Table 1. In conventional frozen yoghurt, the overrun ranged from 49 to 52% with an average of 50%, melting time ranged from 5.0 to 5.4 min with an average of 5.3 min, percent Titratable Acidity (TA) ranged from 0.71 to 0.80 with an average of 0.74 while sensory scores ranged from 6 to 7 with an average of 6.7 out of 9.0. In contrast, the average values for modified frozen yoghurt were higher in respect of all characteristics such as overrun (77%), TA (0.92%), sensory scores (6.8) and melting time (5.4 min). Whey solids, especially whey proteins, have been shown to possess very good emulsifying property (Molder and Jones, 1987) and the presence of whey solids in yoghurt would have enabled it to hold large volumes of air during freezing resulting in enhanced overrun. Higher titratable acidity in modified frozen yoghurt could be due to the better growth of starter cultures in the presence of whey solids.

The viable counts of yoghurt starters both in conventional and modified yoghurts are given in Table 2. The results show that the viable counts ranged from 4.7×10^8 cells per g to 6.2×10^8 cells per g with an average of 5.5×10^8 cells per g in conventional yoghurt before freezing. However after freezing there was a small increase in the average viable count (5.9×10^8 cells per g). In modified yoghurt, the viable count was in the range of 5.6×10^8 cells per g to 8.2×10^8 cells per g with an average of 6.7×10^8 cells per g. On freezing the modified yoghurt, the average viable count showed a marginal increase to 7.2×10^8 cells per g. Higher growth of starters in modified yoghurt is suggestive of the presence of stimulating substances in whey solids. The whey proteins, lactalbumin and lactoglobulin have been shown to enhance the multiplication of starter cultures (Mehanna and Gonc, 1988). A small increase

Table 1. Characteristics of conventional and modified frozen yoghurts.

	Trial	Overrun (%)	Melting Time (min)	Titratable Acidity	Sensory Scores (Max:9)
Conventional frozen yoghurt	1	50	5.2	0.75	6.50
	2	52	5.3	0.72	7.00
	3	49	5.0	0.71	6.50
	4	50	5.4	0.80	7.50
	5	51	5.3	0.73	6.0
Average		50	5.3	0.74	6.70
Modified frozen yoghurt	1	76	5.3	0.90	7.0
	2	79	6.0	0.85	7.0
	3	75	5.2	1.00	6.5
	4	79	5.2	0.96	6.5
	5	79	5.2	0.96	6.5
Average		77	5.4	0.92	6.8

in the viable count was observed in this study on freezing the yoghurt. This increase could be due to aeration of the mix at low temperature resulting in separation of clumps into individual bacterial cells and also due to fragmentation of long chains. Both conventional and modified frozen yoghurts possessed adequate concentrations of viable yoghurt cultures. Tienzen and Baer (1989) and Bieleoka *et al.* (1989) have reported the presence of appreciably large number of starter cultures in frozen yoghurts.

In order to produce a frozen product whose sensory scores were higher than that of modified frozen yoghurt, modified yoghurt was blended with different proportions of ice cream mix and then frozen. It is seen in Table 3 that out of 5 blends prepared, the blend containing modified yoghurt and ice cream mix in the ratio of 40 : 60 obtained the highest sensory scores of 8.5 while the blend of 20 : 80 ratio secured the lowest scores of 7.0. In the 40 : 60 blend the melting time was highest (8.2 min). The melting time of the frozen

Table 2. **Viable starter count cfu per g × 10^8 of conventional and modified frozen yoghurts.**

Trial	Viable starter count			
	Conventional Yoghurt		Modified Yoghurt	
	Before freezing	After freezing	Before freezing	After freezing
1	5.1	4.6	6.3	6.6
2	6.2	6.8	7.0	7.5
3	5.4	5.8	6.4	6.9
4	6.1	6.5	8.2	8.6
5	4.7	4.9	5.6	5.9
Average	5.5	5.9	6.7	7.2

Table 3. **Characteristics of frozen blends of modified yoghurt and ice cream mix.**

Yoghurt : ice cream mix blends	Overrun (%)	Melting time (min)	Titratable Acidity (%)	Sensory Scores (Max : 9)
10 : 90	86	7.0	0.58	7.5
20 : 80	83	7.5	0.62	7.0
30 : 70	81	8.0	0.65	8.0
40 : 60	78	8.2	0.70	8.5
50 : 50	76	8.1	0.75	8.0
SEM + (%)	0.76	0.16	0.22	0.17
CD (P<0.05)	2.35	0.50	0.68	0.52
CV	1.98	4.27	4.97	0.21

Table 4. Viable starter counts cfu per g × 10^8 of frozen yoghurt dessert (40 : 60 blend).

Trial	Viable starter count		
	Before freezing	After freezing	After storing for 10 days at -20°C
1	4.8	4.5	1.00
2	4.2	4.0	1.50
3	4.5	3.9	0.90
4	5.0	4.6	1.20
5	4.9	4.4	1.20
Average	4.7	4.3	1.16

yoghurt would be influenced by the casein content and the amount of free water (Sienkiewiez and Riedel, 1990). Olsen (1990) also developed a modified frozen yoghurt by blending ice cream mix and plain yoghurt in the ratio of 40 : 60.

The therapeutic value of the frozen yoghurt is measured in terms of the presence of the viable starter count. The frozen yoghurt dessert (40 : 60 blend) possessed 4.3 × 10^8 cells per g of the product and the viable count was marginally reduced to 1.16 × 10^8 cells per g even after a storage period of 10 days at -20°C (Table 4).

The dessert developed in this study possessed desirable acidity (0.7% lactic acid), sufficiently long melting time (8.2 min), sufficient viable cells (4.3 × 10^8 cells per g) and a very good acceptability (sensory score of 8.5 out of 9).

CONCLUSION

The study revealed that a blend of 40% yoghurt and 60% ice cream mix when frozen yielded a dessert with comparatively better overrun, melting resistance, sensory characteristics and desirable acidity. It also contained adequate level of yoghurt culture that could enhance the nutritional and therapeutic properties. This blend may also be altered to meet variation of preference of the consumers.

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