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Development of High Protein Ice-Cream Using Milk Protein Concentrate

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Abstract: *Vanilla ice cream contained 9.56% milk fat, 11.0% milk SNF, 13% beet sugar, and 4% 36 dextrose-equivalent corn syrup solids. The control contained 3.74% protein and was not supplemented with milk protein concentrates. Treatments 2 and 3 (T_2 and T_3) were supplemented with milk protein concentrates and contained 40, 60 per cent increased protein level respectively. The ash and lactose content of all the treatments showed a decreasing trend as the protein content increased. Maximum overrun was obtained for T_2. Viscosity also decreased as the protein content increased. Milk protein level influenced ice crystal size; with increased protein, the ice crystal size was favourably reduced in treatments. In terms of overall acceptability, it was however observed that T_1 (5.4) was scored higher than T_2 (4.8). T_4 was the most acceptable ice cream. It is concluded that it is possible to produce acceptable ice cream with higher levels of protein.*
Keywords: *Ice cream; Protein; MPC*

I. Introduction

Ice cream may be defined as a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavor, with or without stabilizer or color and with the incorporation of air during the freezing process. It is equally liked the people of all age groups; whether it be children or the elderly.

Milk protein concentrate (MPC) is any type of concentrated milk product that contains 40–90% milk protein. It is a high protein spray dried powder manufactured from skim milk by means of membrane separation (Anema et al 2006). In addition to ultrafiltered milk products, the MPC classification includes concentrates made through other processes, such as blending nonfat dry milk with highly concentrated proteins, such as casein. Milk protein concentrate is produced by UF and diafiltration of milk, followed by a 2-stage drying process of evaporation and spray drying. MPC contains micellar casein, whey proteins, and bioactive proteins in the same ratio found in milk. As the protein content of MPC increases, the lactose levels decrease. This high-protein low-lactose ratio makes MPC an excellent ingredient for protein-fortified beverages and foods and low-carbohydrate foods. MPC can make products more heat stable, and it can provide solubility and dispersibility when used. Milk protein concentrate formulations were found to have higher ice cream mix viscosity, narrower ice melting curves, and greater shape retention in ice cream (Alvarez et al., 2005).

Hence the present study was conducted to develop a high protein acceptable ice-cream using milk protein concentrate.

II. Material And Methods

2.1 Manufacture of ice cream mix:

Ice cream contained 9.56% milk fat, 11.0% milk SNF, 13% beet sugar, and 4% 36 dextrose- equivalent corn syrup solids. Ice cream samples were targeted to contain 37% total solids. Stabilizers and emulsifiers were not added to any sample. The control contained 3.74% protein and was not supplemented with milk protein concentrates. Treatments 2 and 3 (T_2 and T_3) were supplemented with milk protein concentrates (70.0% protein) and contained 40, 60 per cent increased protein level respectively, as compared with T_1. Fat and total solids for milk, cream and condensed milk were analyzed. Ice cream mix was made in three batches and each batch of 10 kg represented one sample. Ice cream mixes were made by first heating the liquid ingredients (cream, milk, condensed skim milk and water) to 43°C in an ice cream mix tank. Other ingredients (beet sugar, corn syrup solids and whey protein concentrates or milk protein concentrates) were added at this point, mixed for 10 to 15 minutes. Mixes were pasteurized by high temperature short time pasteurization at 82°c for 25 seconds. After the mix was homogenized on a homogenizer with 2000 psi pressure on the first stage, and 500 psi pressure on the second, mixes were cooled and stored at 4°c overnight. Three replicates were taken from each mixture sample.

Table 1: Ice cream Mix Treatments

Treatment	Milk Protein Concentrate			
	0%	40%	60%	80%
T_1	✓			
T_2		✓		
T_3			✓	
T_4				✓

2.2 Ice cream mix analysis:

Ice cream mixes were analyzed for fat, total solids, total nitrogen content, protein content, pH, titratable acidity, freezing point, ash content, lactose content and viscosity of the mix.

Fat% was estimated by means of Gerber test. In this test we use butyrometers, rubber stoppers for butyrometers, 10.94 ml pipettes for mix, 10 ml pipettes or dispensers for Garber acid, 1 ml pipettes or dispensers for amyl alcohol and stands for butyrometers. Protein content was determined by multiplying the total nitrogen content estimated by kjeldahl method by a factor of 6.38. The procedure was modified according to the amount of protein in the ice cream mix. For the control (T_1), 3 g was weighed, for T_2 containing a 40% increase in protein, 2 g was weighed, for T_3 with 60% increase in protein 1.5 g of sample was weighed and for T_4 containing 80% increase in protein, 1.0 gm was weighed.

$$\% \text{ Protein} = \% \text{ Nitrogen} * 6.38$$

Titrable acidity, expressed as percentage lactic acid was determined by taking 10 ml of ice cream mix and adding 50 ml of water to it. Then few drops of phenolphthalein indicator were added and were then titrated with 0.1 N NaOH by continuous mixing until a faint pink color appeared.

$$\text{Acidity\%} = \text{Titre value}*0.09$$

Total solids were measured by gravimetric method while pH meter was measured with the help of a pH meter. Lactose content of mix was determined by difference wherein milk fat, protein, ash, beet sugar and corn syrup solids were detected from total solid content.

2.3 Ice cream preparation and analysis:

Real vanilla extract was added at the rate of 50 ml per 10 ml of ice cream mix prior to freezing. The ice cream mix so prepared was frozen in a batch freezer with a target of about 90% overrun. Overrun was calculated on weight basis. Ice cream was allowed to harden at -28°C to -35°C and analyzed for crystal size after one week. A light microscope was used to determine the mean ice crystal size of the ice creams.

2.4 Sensory Evaluation:

The ice creams prepared were presented to a panel of ten judges for sensory evaluation. Samples were rated for overall texture acceptance and overall flavour acceptance. Scoring was done on the basis of Hedonic scale ranging from 1 to 9 (1 = dislike extremely, 3 = dislike moderately, 5 = neither like nor dislike, 7 = like moderately, and 9 = like extremely).

III. Results And Discussion

Milk fat of the all the treatments was same. Milk fat of the ice cream mixes ranged from 9.47 to 9.56% (Table 2). Fat plays an important role in the stabilization of the ice cream structure, as partially coalesced fat is mainly responsible for stabilizing the air bubbles and the foam structure (Koxholt et al 2001). Total solids were targeted at 37%, ranged from 36.36 to 36.49%, and were similar among treatments (Table 2). When hardening to the same storage temperature, more water has to be frozen for ice cream mix with low TS compared with ice cream mix with high TS, which has comparatively less water content. Increase in protein content was obtained as expected as the amount of protein was increased by 40, 60 and 80% by the addition of milk protein concentrates. As shown in table 2, the protein content of mixes varied from 3.74 in control (T_1) to 7.08 in T_4. Proteins contribute to the development of structure in ice cream, including emulsification, whipping, and water-holding capacity (Schmidt, 1994; Walstra and Jonkman, 1998). The ash and lactose content of all the treatments was observed to be same. However, slight reductions were observed in ash content as the amount of protein increased. A trend of reduction in ash content was observed as the protein content of the mix was increased (Patel et al 2006).

Table 2: Composition of the Ice cream mix

Treatments	Milk Fat (%)	Total Solids (%)	Protein	Ash	Lactose
T_1	9.56 ±0.06	36.34 ± 0.33	3.74 ±0.35	0.81 ±0.03	5.91 ±0.02
T_2	9.53 ±0.09	36.38 ±0.37	5.16 ±0.08	0.78 ±0.03	4.68 ±0.07
T_3	9.51 ±0.16	36.36 ±0.35	6.00 ±0.03	0.72 ±0.03	4.14 ±0.05
T_4	9.47 ±0.05	36.49 ±0.07	7.08 ±0.06	0.65 ±0.06	3.59 ±0.05
F-value	0.48^{NS}	0.14^{NS}	185.15**	10.41**	0.00^{NS}

** Means significant at a level of 5% NS- difference between means non-significant

Table 3 depicts the characteristics of the mix prepared. Ice cream mix pH values ranged from 6.64 and 6.73. Milk SNF is related to pH of the mix. Increase in SNF content of ice-cream has been associated with increase in acidity, thereby decline in pH. Titrable acidity increased with protein content due to increase in albumin and casein (Patel et al 2006). Viscosity is defined as the resistance to flow. One percent WPC substituted for 1% NDM had no effect on ice cream mix viscosity (Ruger et al., 2002). T_2 was found to have the lowest viscosity while highest viscosity was observed for T_3.

Table 3: Characteristics of the Ice cream mix

Treatments	pH	Titrable Acidity	Viscosity
T_1	6.64 ± 0.02	0.18 ± 0.01	0.27 ± 0.02
T_2	6.67 ±0.02	0.20 ±0.02	0.08 ±0.03
T_3	6.71 ±0.03	0.20 ±0.01	0.77 ±0.04
T_4	6.73±0.01	0.21 ±0.01	0.59 ±0.06
P-value	<0.05	<0.05	>0.05**

** Means significant at a level of 5%

Overrun is the term for the percent of expansion of ice cream achieved from the amount of air incorporated into the product during the freezing process. It is achieved by whipping the mix. It makes the icecream smooth and reduces crystal size. Overrun percentage in the present study ranged from 84.73 for T_1 to 90.72 for T_2 (Table 4). Ice creams with increased protein content had decreased ice crystal size.

After the ice- cream mixes were analysed for their characteristics in the laboratory, these were judged by a panel of ten judges for sensory evaluation. It was found that as the protein content of ice cream increased, the consumer acceptability increased. As represented in table 5, Lowest scores were obtained for T_1 (4.2). This showed that the increase in protein improved the textural traits of ice cream like iciness and creaminess. For flavour, the scores obtained were similar for T_1 and T_2 (Table 5). In terms of overall acceptability, it was however observed that T_1 (5.4) was scored higher than T_2 (4.8). T_4 was the most acceptable ice cream.

Table 4: Ice cream characteristics

Treatments	Osverrun	Draw Temp (°C)	Ice crystal size
T_1	84.73 ±0.78	-5.17 ± 0.25	39.46 ± 2.56
T_2	90.72 ±0.72	-4.37 ±0.12	34.89 ±0.59
T_3	87.11 ±0.69	-4.00 ±0.10	31.33 ±1.82
T_4	89.07 ±0.66	-3.90 ±0.30	30.59 ±0.67
P-value	>0.05**	>0.05**	>0.05**

** Means significant at a level of 5%

Table 5: Sensory evaluation of Ice cream mixes

Treatments	Texture Acceptability	Flavour Acceptability	Overall acceptability
T_1	4.2 ± 0.84	5.2 ± 0.45	5.4 ± 0.89
T_2	5.4 ± 0.55	5.2 ± 0.45	4.8 ± 0.84
T_3	6.2 ± 0.45	6.4 ± 0.55	5.6 ± 0.55
T_4	6.6 ± 0.55	6.8 ± 1.30	7.6 ± 0.55

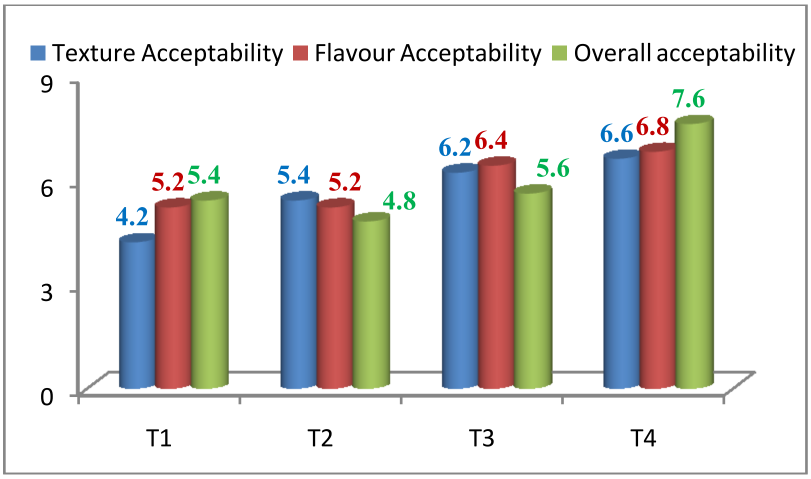

Figure 1: Acceptability Scores of the prepared ice cream

IV. Conclusion

Ice cream was successfully made by increasing the protein content by adding milk protein concentrate. Milk fat and total solids of the all the treatments was same. Milk fat of the ice cream mixes ranged from 9.47 to 9.56%. Total solids were targeted at 37%, ranged from 36.36 to 36.49%, and were similar among treatments. The ash and lactose content of all the treatments showed a decreasing trend as the protein content increased. Maximum overrun was obtained for T_2. Viscosity also decreased as the protein content increased. In terms of overall acceptability, it was however observed that T_1 (5.4) was scored higher than T_2 (4.8). T_4 was the most acceptable ice cream.

References

[1]. Anema S.G., Pinder D.N., Hunter R.J. and Hemar Y. (2006) Effects of storage temperature on the solubility of milk protein concentrate (MPC85) *Food Hydrocolloids*. 20 (2–3): 386–393

[2]. Alvarez, V. B., Wolters C. L., Vodovotz Y., and Ji T.. (2005) Physical properties of ice cream containing milk protein concentrates. J. Dairy Sci. 88:862–871.

[3]. Koxholt M.M.R, Eisenmann B, and Hinrichs J. Effect of the Fat Globule Sizes on the Meltdown of Ice Cream

[4]. Walstra, P., and M. Jonkman. (1998). The role of milkfat and protein in ice cream. Pages 17–24 in Ice Cream. W. Buchheim, ed. International Dairy Federation Special Issue 9803. International Dairy Federation, Brussels, Belgium.

[5]. Schmidt, K. 1994. Effect of milk protein and stabilizer on ice milk quality. J. Food Qual. 17:9–19.

[6]. Koxholt MMR, Eisenmann B, Hinrichs J. 2001. Effect of the fat globule sizes on the meltdown of ice cream. J Dairy Sci 84:31–7.

[7]. Patel M. R, Baer R. J, and Acharya M. R. (2006) Increasing the Protein Content of Ice Cream. 89 (5): 1400-1406.

[8]. Ruger, P. R., R. J. Baer, and K. M. Kasperson. 2002. Effect of double homogenization and whey protein concentrate on the texture of ice cream. J. Dairy Sci. 85:1684–1692.