EFFECT OF INCORPORATION OF WHEY PROTEIN CONCENTRATE ON QUALITY OF ICE CREAM

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ABSTRACT

Ice cream was prepared by replacing skimmed milk powder (SMP) with whey protein concentrate (WPC) with the objective of improving the quality of ice cream. Ice cream was prepared by replacing SMP at four different levels viz., 10 (T1), 20 (T2), 30 (T3) and 40 (T4) per cent keeping a control without incorporation of WPC. A significant (P<0.05) difference in the acidity of the ice cream was observed between the control and treatments. The fat and total solids contents were not statistically significant between treatments. The protein content of control and the treatments T1, T2, T3 and T4 were 4.63, 5.99, 6.75, 7.55 and 8.36% respectively showing a significant difference (P < 0.01) among treatments. The melting time (in minutes) of the control, T1,T2,T3 and T4 were 6.20, 6.15, 5.44, 4.68 and 4.63 respectively and showed a significant difference (P < 0.01). It was found that the melting time of ice cream decreased as the percentage of WPC increased. All the samples showed no significant difference for total sensory scores. The results suggest that the replacement of SMP up to 40 per cent level with WPC in ice cream mix has increased the protein content of ice cream without affecting its sensory qualities.

Keywords: Ice cream, whey protein concentrate, physico-chemical properties, melting time and sensory qualities.

INTRODUCTION

Ice cream is a delicious and nutritious frozen dessert consumed by people of all age groups. As per the PFA Rules (1976) ice cream should contain not less than 10 per cent fat, 36 per cent total solids and 3.5 per cent protein. The protein content of the ice cream is low. Whey and whey products have been used successfully in ice cream and other frozen dairy desserts for years. Whey Protein Concentrate (WPC) is rich in essential amino acids such as lysine, tryptophan, cystine and methionine. Whey solids possess nutritionally and functionally biologically active superior proteins (Steinholth et al., 1999) and their incorporation in the ice cream mix would result in superior product in terms of increased overrun by reducing freezing time besides increasing the protein content of the ice cream (Vulnik, 1995). It also results in improved creaminess, smoothness and flavour of the ice cream

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(Huse et al., 1984). This paper focuses on the utilization of WPC as nutritional and functional ingredient in ice cream, by replacing the skimmed milk powder at 10, 20, 30 and 40 per cent levels.

MATERIALS AND METHODS

Fresh cow milk was obtained from the Livestock farm, Veterinary College and Research Institute, Namakkal. Whey protein concentrate (82 per cent protein) was procured from Kanishka Flora Chem (India), Chennai and butter (Aavin), skimmed milk powder (Sagar), stabilizer, emulsifier, sugar, and vanilla flavour were purchased from the local market.

Necessary calculations were made so as to have the level of fat (10%) and total solids (36%) in ice cream to be in compliance with the standards prescribed by BIS(1964) (Table.1). Accordingly, calculated quantity of milk and butter was heated to 65o C and then homogenized by a two stage homogenizer (I stage 2500 psi and II stage 500 psi) to make uniform emulsion. The mix was then heated to 75oC, followed by addition of the skimmed milk powder, sugar, stabilizer and emulsifier with constant stirring so as to dissolve the constituents completely, then pasteurized at 80°C for 30 minutes and aged overnight at 5°C. After ageing, the mix was frozen using a batch freezer and the prepared control ice cream samples were hardened and stored at -23 to -18o C (Arbuckle, 1972). Similarly ice cream samples of different treatment groups were prepared by replacing skim milk powder at 10, 20, 30 and 40 per cent levels with whey protein concentrate.

The control and treatment ice cream samples were subjected to sensory evaluation using modified version of ADSA ice cream score card (Bodyfelt et al.,1988) by a panel of six judges. Maximum scores allotted for flavour, body and texture, melting quality, colour, appearance and packaging (CAP) and bacterial count were 10, 5, 3, 5 and 2 respectively. Full marks (2/2) were given for bacterial count in the score card. Statistical analysis of data of the six replications were carried out by using completely randomized block design (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The mean fat and total solids percentage of the control and treatments were maintained at 10 and 36 per cent levels as prescribed by the BIS (1964). It is inferred from the table 1, that the statistical analysis of the data for fat and total solids showed no significant difference between control and treatments. A significant difference ($P<0.05$) in titratable acidity (in percentage) was noticed. Progressive increase in the titratable acidity was found in the treatments as the concentration of WPC increased when compared to the control but no difference in titratable acidity (in percentage) were observed between T1 & T2 and T3 & T4 respectively . Increase in the titratable acidity in the respective treatments could be correlated with the increase in the WPC content as reported by Suneeta et al., (2007) and Khillari et al., (2007).

A significant ($P<0.01$) increase in protein content from 4.63 (Control) to 8.36 (T4) was observed. The increase in the protein content (table 2) in the treatments T1, T2, T3 and T4 can be attributed to the use of whey protein concentrate with higher protein content (82%). The use of WPC would allow the maintenance of high protein levels with consequent nutritional and possible functional benefits. The melting resistance of ice cream samples containing whey protein concentrate significantly ($P<0.01$) increased with the increasing level of WPC. This was I in accordance with the reports of Magdoup et al., (1992), Kebary and Hussain (1997) and Khillari et al., (2007) who reported that incorporation of WPC improved the melting characteristics significantly ($P < 0.01$). The findings of Suneeta et al., (2007) was also in accordance with the present values that addition of WPC up to 40 per cent level by replacing the skimmed milk powder in the ice cream mix improved the melting quality of the samples.

Table.3. showed that the total score for the control was 19.47± 0.18 and more (or) less same for treatments T1, T2, T3 and T4 were 19.30 ± 0.44, 19.87 ± 0.31, 20.00 ± 0.22 and 19.83 ± 0.28 respectively. Mean flavour score did not differ significantly among the control and treatments. Similarly the body and texture, CAP scores for the control and treatments showed no significant difference. Suneeta et al., (2007) opined that the body and texture and CAP scores of the ice cream samples incorporated with WPC were at par with those of control samples.

The standard plate count of control and treatment samples showed a significant ($P<0.01$) difference. But, the standard plate count is within the limits as prescribed by the Bureau of Indian Standards (1964). The coliform count of control and treatments showed no significant difference and the counts were within the limits as prescribed by the BIS (1964).

CONCLUSION

Whey protein concentrate as nutritional and functional ingredient contain biologically active proteins has been used to replace by the skimmed milk powder at 10, 20, 30 and 40 per cent levels in the ice cream preparation to enhance the protein content. The WPC incorporated ice cream samples had sensory characteristics similar to that of control ice cream samples. Hence, it is concluded that whey protein concentrate can be incorporated up to 40 per cent level in the ice cream replacing skimmed milk powder to enhance the protein content of the ice cream without affecting sensory qualities.

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Table 1

Quantity of ingredients for 1000 gram of Ice cream mix

Ingredients	Control	Level of replacement of WPC			
		T1 - 10%	T2 - 20%	T3 - 30%	T4 - 40%
Milk	711.67	711.67	711.67	711.67	711.67
Skimmed milk powder	46.00	41.40	36.80	32.20	27.60
WPC	0.00	4.60	9.20	13.80	18.40
Butter	89.00	89.00	89.00	89.00	89.00
Sugar	150.00	150.00	150.00	150.00	150.00
Stabiliser and Emulsifier	3.33	3.33	3.33	3.33	3.33
Total	1000.00	1000.00	1000.00	1000.00	1000.00

Table 2

Effects of WPC incorporation on the physico-chemical and microbiological properties (Mean ± SE) of ice cream

Parameters	Control	T1	T2	T3	T4
Fat %	10.35 ± 0.09	10.35 ± 0.07	10.23 ± 0.03	10.6 ± 0.04	10.25 ± 0.07
Total solids %	36.30 ± 0.07	36.26 ± 0.10	36.23 ± 0.04	36.35 ± 0.07	36.28 ± 0.06
Titratable acidity % (lactic acid)	0.20 ± 0.004^{A}	0.21 ± 0.003^{B}	0.21 ± 0.004^{B}	0.22 ± 0.003^{C}	0.22 ± 0.004^{C}
Protein %	4.63 ± 0.05^{a}	5.99 ± 0.05^{b}	6.75 ± 0.06^{c}	7.55 ± 0.07^{d}	8.36 ± 0.04^{e}
Ice cream, g melted (in minutes)	6.20 ± 0.07^{c}	6.15 ± 0.06^{c}	5.77 ± 0.08^{b}	4.68 ± 0.11^{a}	4.63 ± 0.13^{a}
SPC (cfu/ml)	52.00 ± 3.46^{a}	58.17 ± 3.40^{a}	55.17 ± 3.99^{a}	74.50 ± 3.51^{b}	77.00 ± 6.30^{b}
Coliform count (cfu/ml)	16.5 ± 2.06	18.83 ± 1.66	20.83 ± 2.81	17.5 ± 1.70	17.5 ± 0.92

Means bearing different superscripts in capital letters (A, B, C) differ significantly at ($P<0.05$)

Means bearing different superscripts in small letters (a, b, c, d, e) differ significantly at ($P<0.01$)

Table 3

Effects of WPC incorporation on the sensory qualities (Mean ± SE) of ice cream.

Parameters	Control	T1	T2	T3	T4
Flavour (10)	7.42 ± 0.15	7.50 ± 0.18	7.50 ± 0.18	7.33 ± 0.11	7.50 ± 0.00
Body and Texture (5)	3.58 ± 0.20	3.17 ± 0.21	3.58 ± 0.15	3.50 ± 0.18	3.50 ± 0.13
CAP (Colour, Appearance and Packaging) (5)	3.75 ± 0.71	4.00 ± 0.22	3.92 ± 0.15	4.08 ± 0.15	3.92 ± 0.15
Melting Quality (3)	2.47 ± 0.10[a]	2.80 ±0.10 [a]	2.70 ± 0.09 [a]	3.00 ± 0.00 [b]	2.83 ± 0.11 [b]
Bacterial Count (2)	2	2	2	2	2
Total score (25)	19.47± 0.18	19.30 ± 0.44	19.87 ± 0.31	20.00 ± 0.22	19.83 ± 0.28

Means bearing different superscripts in differ significantly at ($P<0.01$)