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INCORPORATION OF WHEY PROTEIN CONCENTRATE IN ICE CREAM

C. PANDIYAN*, G. KUMARESAN, R. ANNAL VILLI and G. RAJARAJAN

Department of Dairy Science, Veterinary College and Research Institute,
NAMAKKAL – 637 002 (T.N.) INDIA

ABSTRACT

Ice cream was prepared by replacing skimmed milk powder with whey protein concentrate (WPC) with the objective of improving the biological value of ice cream protein. Physico-chemical, microbiological and sensory qualities of WPC incorporated ice cream was assessed. Ice cream was prepared by replacing skim milk powder at 0 (control), 10 (T1), 20 (T2), 30 (T3) and 40 (T4) per cent levels. A significant ($P < 0.05$) difference in the acidity of the ice cream was observed between the control and treatments. The acidity was significantly higher at 40 per cent replacement. The fat and total solids contents were not statistically significant between treatments. The mean (± SE) protein content (in per cent) showed a significant difference ($P < 0.01$) among treatments. The protein content of control, T1, T2, T3 and T4 were 4.63 ± 0.05, 5.99 ± 0.05, 6.75 ± 0.06, 7.55 ± 0.07 and 8.36 ± 0.04 respectively. The mean melting time (in minutes) of the control, T1, T2, T3 and T4 were 6.20 ± 0.07, 6.15 ± 0.06, 5.44 ± 0.08, and 4.68 ± 0.11 and 4.63 ± 0.13 respectively and showed a significant difference ($P < 0.01$). As the percentage of WPC increased the melting time of ice cream decreased. The mean standard plate count and coliform count in the control and treatments were within the limits prescribed by Bureau of Indian Standards. The total sensory scores (25 points) had no significant difference between control and treatments. In conclusion, replacement of skim milk powder up to 40 per cent level with whey protein concentrate, did not affect the sensory qualities of the ice cream.

Key words: Ice cream, Whey protein concentrate, Physico-chemical properties, Microbiological and Sensory qualities.

INTRODUCTION

Ice cream is a delicious and nutritious frozen dessert consumed by all age groups. As per the PFA Rules[1] (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 and their incorporation in the ice cream mix would result in superior product in

*Author for correspondence; E-mail: c_pandiyan@rediffmail.com

terms of increased overrun by reducing freezing time besides increasing the protein content of the ice cream[2-4]. It also adds improved creaminess, smoothness and flavour of the ice cream[5]. 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.

EXPERIMENTAL

Materials and methods

Fresh cow milk was procured 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, Butter (Aavin), Skimmed milk powder (Sagar), stabilizer and emulsifier, sugar, and vanilla flavour were procured from the local market.

Preparation of WPC enriched ice cream

As shown in Table 1, calculated quantity of milk and butter was heated to 65°C and then it was homogenized by a two stage homogenizer (I stage 2500 psi and II stage 500 psi)

Table 1: Quantity of ingredients (g) for 1000 g of ice cream mix

Ingredients	Control	% Replacement			
		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

to make uniform emulsion. The mix was then heated to 75°C, followed by addition of the skimmed milk powder, sugar, stabilizer and emulsifier with constant stirring so as to dissolve the constituents completely. The ice cream mix was pasteurized at 80°C for 30 minutes and aged for overnight at 5°C. After ageing, the mix was frozen using a batch freezer and the ice cream samples were hardened and stored at -23 to -18°C[6]. The ice cream samples were prepared by replacing skim milk powder at 10, 20, 30 and 40 per cent levels with whey protein concentrate.

The total solids and fat content of control and experimental ice cream were maintained at 10 and 36 per cent respectively, so as to produce ice cream with proper body and texture. Stabiliser and Emulsifier (SE) were added at rate of three per cent levels.

The control and experimental ice cream samples were subjected to sensory evaluation using modified version of ADSA ice cream score card[7] 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 was carried out by using completely randomized design[8]. The data obtained were given in Table 2.

Table 2: Effects of WPC incorporation on the physico-chemical, microbiological and sensory qualities of ice cream

Parameters	Control	T1	T2	T3	T4
Physico-chemical analysis					
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]
Microbiological analysis					
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
Sensory analysis					
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

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 ISI 1964. The statistical analysis of the data for fat and total solids showed no significant difference between control and treatments. A

significant difference in titratable acidity ($P < 0.05$) was noticed. Progressive increase in the titratable acidity was found in the treatments when the concentration of WPC was increased compared to the control. This increase in the titratable acidity in the treatments could be correlated with the increase in the WPC content. The significant ($P < 0.01$) increase in protein content from 4.63 (Control) to 8.36 (T5) 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[9-12].

The standard plate count of control and treatments showed a significant difference ($P < 0.01$). But, the standard plate count is within the limits as prescribed by the Indian Standards[13]. The coliform count of control and treatments showed no significant difference and the counts were within the limits as prescribed by the Indian Standards.

The mean flavour score did not differ significantly between the control and treatments. Similarly the body and texture, CAP scores for the control and treatments showed no significant difference. Whey protein concentrate incorporated ice cream samples are at par with control for body and texture and CAP scores[11].

Incorporation of WPC improved the melting characteristics significantly ($P < 0.01$) compared to the control. 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[11]. As can be seen from the Table 2, the total score for the control was 19.47 ± 0.18 and the 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. However, there is a little difference in the total score of control and T1, statistical analysis showed no significant difference between control and all the treatments incorporated with different levels of whey protein concentrate.

CONCLUSION

Whey protein concentrate as nutritional and functional ingredient contain biologically active proteins has been replaced 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 similar sensory characters that of control. Hence, it could be concluded that whey protein concentrate could be incorporated in the ice cream replacing skimmed milk powder with improved sensory properties besides improving the protein content of the ice cream.

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