

Ovine Ice Cream made with addition of Whey Protein Concentrates of Ovine-Caprine origin

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Introduction

A common practice in ice cream making is the use of skimmed milk powders (SMP) and whey powders to increase the non-fat milk solids. The most commonly used SMP is of bovine origin. However, in ovine ice cream, the use of powders of ovine or/and caprine origin is very important to keep the identity of the product and to avoid allergens derived from bovine milk. Thus, the aim of this research work was to study the effect of substituting the bovine SMP with whey protein concentrates (WPC) of ovine/caprine origin in the manufacture of low-fat ovine ice cream.

Materials and Methods

Partially defatted ovine milk (fat 0.5%), ovine cream derived from the same milk, SMP (35% protein) or WPC powders, i.e. WPC-65% protein and WPC-80% protein, sugar blend (sucrose : fructose at a ratio 50:50), a commercial blend of stabilizers/emulsifiers and vanilla flavor were used to manufacture three ice creams (A, B and C). The ice cream mixes were formulated as shown in Table 1 and the products were made according to the flow diagram shown in Figure 1 using a laboratory freezer. pH, acidity, α_w , and freezing point were measured in ice cream mix. Gross composition, minerals, overrun, hardness, melting rate and color were determined in the ice cream. In addition, organoleptically evaluation of the products was performed. The obtained data were subjected to statistical analysis by comparing the means using the Least Significant Difference test (LSD, $P < 0.05$).

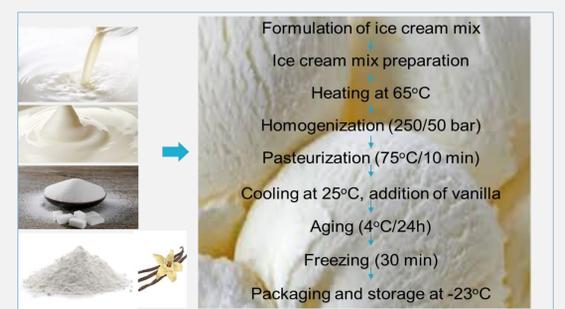


Fig. 1 Flow diagram of ice cream making

Table 1. Formulation of ice cream mix containing SMP (35% protein) or WPC-65%P or WPC-80%P

Ingredient	%
Ovine skimmed milk	78,4
Ovine cream	7,6
SMP / WPC-65%P / WPC-80%P	4
Sucrose/fructose (50/50)	9
Emulsifiers/Stabilizers	1

Table 2. α_w and freezing point of ice cream mix made with SMP (A) or WPC - 65%P (B) or WPC-80%P (C)

Ice cream mix	α_w	Freezing point
A	0.9917 ± 0.0002 ^{a*}	-0.5097 ± 0.0154 ^a
B	0.9892 ± 0.0004 ^b	-0.4662 ± 0.0033 ^b
C	0.9884 ± 0.0003 ^b	-0.4530 ± 0.0077 ^b

Table 3. Gross composition (%), pH and acidity of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

Ice cream	Fat	Protein	Carbohydrate	Ash	Total solids	pH	Acidity
A	4.90 ± 0.11	6.92 ± 0.05 ^{a*}	13.71 ± 0.50 ^a	1.12 ± 0.05 ^a	26.19 ± 0.22	6.74 ± 0.02 ^a	0.18 ± 0.01 ^a
B	5.34 ± 0.25	8.15 ± 0.11 ^{a,b}	12.69 ± 0.15 ^b	0.89 ± 0.06 ^b	26.88 ± 0.52	6.69 ± 0.00 ^b	0.19 ± 0.00 ^b
C	4.97 ± 0.49	8.30 ± 0.72 ^b	11.73 ± 0.45 ^b	0.88 ± 0.02 ^b	25.83 ± 1.77	6.67 ± 0.00 ^c	0.21 ± 0.00 ^c

*Means with different superscript letters in the same column differ significantly ($P < 0.05$)

Main Results

- α_w value of both, ice cream mix B and C was lower than α_w value of ice cream mix A, whereas the latter presented significantly ($P < 0.05$) lower freezing point (Table 2).
- Protein content of ice cream C was significantly ($P < 0.05$) higher than ice cream A, while carbohydrate content as well as ash content of both, ice cream B and C were significantly ($P < 0.05$) lower (Table 3). It is noteworthy that all ice creams had similar total solids concentration.
- Calcium and magnesium content were significantly ($P < 0.05$) higher in ice cream A (Table 4).
- The overrun of ice cream A was 76% and it was significantly ($P < 0.05$) higher than the overrun of ice cream B (46%) and of ice cream C (36%). The latter exhibited significantly ($P < 0.05$) increased hardness (Fig. 2,3).
- The melting rate was lower in the case of ice creams B and C than in ice cream A (Fig. 4).
- Ice cream A was significantly ($P < 0.05$) brighter, whereas ice creams B and C were more yellowish (Table 5).
- Ice cream A obtained higher scores as far as flavor concerned (Fig. 5)

Table 4. Minerals (mg/100g) of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

Ice cream	Ca	Mg	K	Na
A	134.45 ± 3.73 ^{a*}	25.74 ± 0.20 ^a	193.09 ± 18.09	127.74 ± 42.29
B	107.91 ± 5.38 ^b	24.41 ± 0.13 ^b	170.21 ± 12.54	109.12 ± 3.16
C	112.49 ± 5.25 ^b	23.18 ± 0.62 ^c	160.23 ± 13.69	116.56 ± 4.78

*Means with different superscript letters in the same column differ significantly ($P < 0.05$)

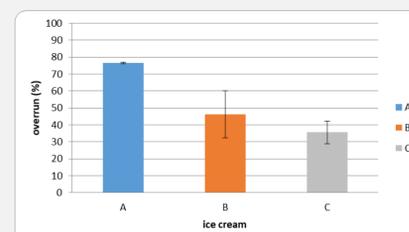


Fig. 2 Overrun of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

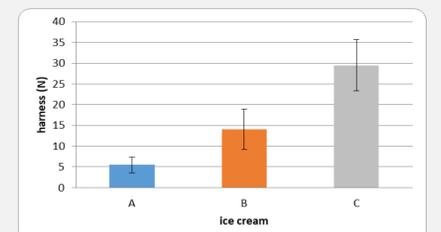


Fig. 3 Hardness of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

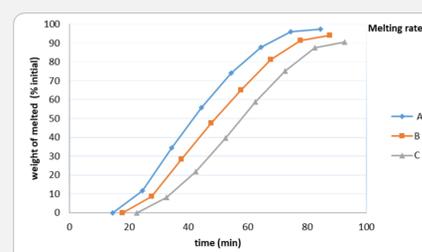


Fig. 4 Melting rate of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean value, n=3)

Table 5. Color characteristics of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

Ice cream	L	a	b
A	82,97 ± 1,06 ^{a*}	-2,60 ± 0,10 ^a	6,83 ± 0,29 ^a
B	80,30 ± 0,79 ^b	-2,50 ± 0,10 ^a	8,30 ± 0,52 ^b
C	80,80 ± 1,04 ^b	-2,30 ± 0,00 ^b	8,83 ± 0,49 ^b

*Means with different superscript letters in the same column differ significantly ($P < 0.05$)



Fig. 5 Sensory evaluation of low-fat ovine ice cream made with addition of SMP (A) or WPC-65 %P (B) or WPC-80%P (C) (mean ± SD, n=3)

Conclusion

The substitution of bovine SMP with ovine/caprine WPC in ovine ice cream manufacture, apart from the definition of the product as 'exclusive ovine' resulted in a dietary ice cream since it contained more protein and less carbohydrate. In addition, taking into consideration other characteristics such as the melting rate, the use of ovine/caprine WPC, especially that with 65% protein, seems to be feasible and further study is needed to optimize the production.

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