

Physico Chemical Characteristics of Dietetic Ice Cream developed by with Sunflower Oil Rice Bran Wax Organogel

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Abstract

Objectives: An experiment has been carried out to study the milk fat replacement with sunflower oil rice bran wax organogel on physico chemical characteristics of ice cream. Sunflower oil rice bran wax organogel was produced by combining 10% (wt) of RBW and 90% (wt) of sunflower oil. **Methods:** Sunflower oil rice bran wax organogel was used at 0, 2.5, 5.0, 7.5 and 10.0 % as a milk fat replacer to develop dietetic ice cream. Ice cream formulation was comprised with standard formulations. **Findings:** The mean value of pH in the control ice cream mix was 6.39 ± 0.014 and in the treatment groups ranged from 6.36 to 6.40. The titrable acidity of different treatment ice creams ranged from 0.214 to 0.217 % and in control ice cream 0.214%. Similarly the control ice cream mix viscosity was 66.12 and in the treatment groups ranged from 60.17 to 65.82. Mean value of overrun in the control ice cream was 37.63% and it ranged from 26.79 to 34.55 % in different treatment ice creams. The mean whipping ability of control ice cream was 46.95% and it ranged from 37.5 to 45.14 % in the treatments. **Application:** It can be concluded that milk fat replacement with sunflower oil rice bran wax organogel did not have any impact on pH, titrable acidity but in viscosity, whipping ability and overrun up to 5% sunflower oil organogel incorporation comparable with control ice cream beyond that there was decreasing trend was noticed.

Keywords: Ice Cream, Organogels, Overrun, Sunflower Oil, Titrable Acidity, Whipping Ability

1. Introduction

Ice cream is a delicious and nutritious frozen dairy dessert with high calorific value. Nowadays there has been increasing demand for low fat or no fat products, as a result of awareness on the harmful effect of excess fat on human health¹. Normally, ice cream has a fat content of 10-14 % with high proportion of saturated fatty acid (60-70 %). The saturated fatty acid content of ice cream can be effectively lowered by substitution of milk fat by sunflower rice bran wax organogel². The risk associated with the consumption of *trans* and saturated fat has been intensely discussed during the last few decades. On the other hand, the consumption of oil as a dietary source of omega-3 and omega-6 fatty acids has been suggested

since it provides numerous benefits to health including reducing the risk of developing heart disease¹.

The application of organogels in food to substitute *trans* and saturated fat arise from their solid-like rheological properties. Because of that fact, these materials have the potential to confer structure and enhance textural quality of food products. Recently, some food grade organogelators have been suggested and the application of innovative organogelators and the progression in the application of organogels in food is still very limited. Hence, a study has been carried out to find out the effect of milk fat replacement with sunflower oil rice bran wax organogel on physical and chemical characteristics of dietetic ice cream.

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2. Materials and Methods

Sunflower oil rice bran wax organogel was used at 0, 2.5, 5.0, 7.5 and 10.0 % as a milk fat replacer to develop dietetic ice cream as detailed below.

Table 1. Experimental groups

Treatments	Details	Milk fat replacement
Control	Ice cream with 10% milk fat	0%
T1	7.5% milk fat + 2.5% sunflower oil rice bran wax organogel	2.5%
T2	5% milk fat + 5.0 % sunflower oil rice bran wax organogel	5.0%
T3	2.5% milk fat + 7.5% sunflower oil rice bran wax organogel	7.5%
T4	10% sunflower oil rice bran wax organogel	10.0%

2.1 Sunflower Oil Rice Bran Wax Organogel Production

Sunflower oil rice bran wax organogel was produced by combining 10% (wt) of RBW and 90% (wt) of sunflower oil. The temperature of the blend was raised up to 80°C to melt the wax. The hot blend was vigorously stirred and homogeneous dissemination of the wax in the oil.

2.2 Ice Cream Formulation

Product formulation was comprised of 12% SNF, 10% fat, 15% sugar, 0.5% stabilizer and Total solids 36.0% as per the Food Safety and Standard Regulations (2011). The content level of ingredient was found out through mathematical calculation and for a batch size of 1000 g (Table 2). The guidelines prescribed² and the flow chart indicated³ was followed in the preparation of ice cream.

Table 2. Formulation of ice cream

Ingredient	Control	T1	T2	T3	T4
Skim milk	715	719	723.5	727.5	731.5
Butter	92.5	69.5	46	23	0
Sunflower oil rice bran wax	0	19	38	57	76

Skim milk powder	50	50	50	50	50
Sugar	140	140	140	140	140
Stabilizer and Emulsifier	1.5	1.5	1.5	1.5	1.5
Flavouring Agent	1	1	1	1	1
Total	1000	1000	1000	1000	1000

2.3 Physico Chemical Analysis

Ice cream mix was subjected to physicochemical analyses and six ice cream samples were analyzed. The pH of ice cream mix was estimated after ageing using a digital pH meter while the titratable acidity calculated as percentage of lactic acid was determined by titration with 0.1 N of sodium hydroxide⁴. The whipping ability of the product was determined by the procedure outlined⁵. While the mix was being frozen in a softy ice cream freezer, a certain volume of mix drawn at five minutes intervals up to ten minutes and weighed. The loss of weight of the mix due to air incorporation was recorded. Overrun measurement was taken by using a known volume (20 mL) of ice cream mix and frozen ice cream to determine both the weight of ice cream mix and ice cream. The overrun was calculated on a weight basis using a formula described⁶. Ice cream mix was also analyzed for protein content and fat content by applying the Kjeldahl method⁷ and modified Gerber method respectively⁷. Total solid content of ice cream was determined as stated in Association of Official Analytical Chemists⁷

2.4 Statistical Analysis

SPSS statistical software was used to statistically analyze all the results obtained from physicochemical analysis. One-way Analysis Of Variance (ANOVA) was performed and the significant difference was defined at $p < 0.05$ for the results of all analysis with different ice cream formulations. The final results obtained were expressed as the mean values with standard deviation.

3. Results and Discussion

Sunflower oil rice bran wax organogels was used at 0, 2.5, 5.0, 7.5 and 10.0 % level to replace milk fat of ice cream and in control ice cream 10 per cent milk fat was used.

3.1 Physico Chemical Analysis of Ice Cream Mix pH

The mean value of pH (Table 3) in the control ice cream mix was 6.39 and in the treatment groups ranged from 6.36 to 6.40. The addition of sunflower oil RBW organogel did not have any effect on the pH of the ice cream mix in the treatment groups and comparable as that of control ice cream mix. ⁸Who observed that incorporation of flaxseed oil at 2.5, 5.0 and 7.5 % in place of milk fat had no significant effect on the pH of ice cream. Similarly, ⁹reported that up to 8.0% replacement of milk fat with coconut oil had no significant effect on the pH in ice cream. ¹⁰Also opined that there was no significance difference was observed up to 3% incorporation of *Moringaoleifera* oil in pH of the ice cream.

Table 3. pH, titrable acidity and viscosity of ice cream mix

Attribute	pH	Titrable acidity	Viscosity (cP)
Control	6.39 ± 0.014	0.214 ± 0.002	66.12 ^c ±0.59
T1	6.40 ± 0.010	0.216 ± 0.001	65.38 ^c ±0.52
T2	6.39 ± 0.011	0.214 ± 0.002	64.77 ^c ±0.56
T3	6.36 ± 0.018	0.217 ± 0.001	61.76 ^{ab} ±0.67
T4	6.37 ± 0.013	0.217 ± 0.001	60.17 ^a ±0.55

Values are Mean ±SE of six observations (n = 6).

Values bearing different superscript in a column differ significantly at (P<0.05).

3.2 Titrable Acidity

In the present study, the titrable acidity of different treatment ice creams (0.214 to 0.217 %) was similar to that of control ice cream (0.214%) and there was no significant difference observed among the treatments. ¹¹Reported that the titrable acidity of different treatment ice creams ranged from 0.20 to 0.21 %. These results were also supported by ¹²who reported that the normal titrable acidity ranged from 0.19 to 0.22 %, in control ice cream. Similarly, ⁸observed that flaxseed oil substitution at 2.5, 5.0 and 7.5 % in the place of milk fat had no significant effect on the titrable acidity in ice cream.

3.3 Viscosity

Viscosity of the control ice cream mix was 66.12 and in the treatment groups ranged from 60.17 to 65.38. The addition of sunflower oil RBW organogels resulted in

significant reduction in (P<0.05) viscosity of treatment group of the ice cream mix. However, in sunflower oil RBW organogel incorporated groups, up to 5.0% replacement of milk fat (T1 and T2) has comparable viscosity with control group. ¹⁰Reported that addition of palm olein oil at 3% with addition of milk fat resulted in significant (P<0.01) decrease in viscosity of ice cream mix. Similarly, ¹³observed that replacing butter fat with hydrogenated palm kernel oil decreased the viscosity of ice cream mix. ¹⁴Opined that partial replacement of milk fat with vegetable oils had a pronounced effect on the viscosity of ice cream mix.

3.4 Physico Chemical Analysis of Ice Cream

3.4.1 Overrun

Mean value of overrun (Table 4) in the control ice cream was 37.63% and it ranged from 26.79 to 34.24 % in different treatment ice creams. The control group had a significantly (P<0.05) higher over run than the organogel incorporated treatments. However, among sunflower oil organogel incorporated treatment ice creams, up to 5% addition (T1 and T2), had a comparable overrun percentage with that of control. ¹⁰Reported that the addition of palm olein oil at 3% with 1.5% milk fat significantly (P<0.01) decreased the overrun and the percent reduction was 8.6 over the control group. ⁹Reported that addition coconut oil at 4.0, 8.0 and 12.0 % level in ice cream resulted in significant (P<0.05) decrease in overrun percentage.

Table 4. Overrun and whipping ability of ice creams

Attribute	Overrun (%)	Whipping ability (%)
Control	37.63 ^c ± 0.99	46.95 ^d ± 0.81
T1	34.24 ^{bc} ± 1.60	44.34 ^{cd} ± 1.56
T2	33.38 ^{bc} ± 2.25	42.61 ^{bcd} ± 0.91
T3	30.19 ^{ab} ± 1.35	39.07 ^{ab} ± 1.69
T4	26.79 ^a ± 1.07	37.54 ^a ± 1.98

Values are Mean ±SE of six observations (n = 6).

Values bearing different superscript in a column differ significantly (P<0.05).

3.4.2 Whipping Ability

The mean whipping ability (Table 4) of control ice cream was 46.95% and it ranged from 37.5 to 44.34 % in the treatments. The control was significantly (P<0.05)

higher whipping ability than the organogel incorporated treatments. However, among sunflower oil organogel incorporated treatments, up to 5% addition (both in T1 and T2) had a comparable whipping ability with that of control. Similar observations were made by¹⁴, who reported that whipping ability of ground nut oil mix was lower than control ice cream. This decrease in whipping ability may be attributed in part due to the decrease in viscosity of the experimental mix and to the higher levels of free fat in palm olein which may act as foam depressant and thus lowered whipping ability. ⁸Opined that, in general, as the viscosity increases, the resistance to melting and the rate of whipping ability also will increase. ¹⁵Reported that application of vegetable fat in ice cream increased the whipping ability and biological value.

4. Conclusion

Examination of selected physico chemical properties revealed that sunflower oil rice bran wax incorporation in ice cream did not have any impact on pH, titrable acidity but in viscosity, whipping ability and overrun up to 5% sunflower oil organogel incorporation comparable with control ice cream beyond that there was decreasing trend was noticed. The development of sunflower oil rice bran organogel incorporated ice cream in this study lead a stretched knowledge about organogelation techniques so that food industries can select sunflower oil organogel for use in ice cream preparation while consumers can be benefited from the health promoting properties of sunflower oil together with its desirable effects in product quality.

5. References

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