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Development of Ice Creams from Soybean Milk and Watermelon Seeds Milk and Evaluation of Their Acceptability and Nourishing Potential

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Abstract: Soybean and watermelon seeds are rich source of protein as well as minerals mainly iron yet they are not consumed by a large number of populations instead of their nutritional qualities. Guava is a rich source of ascorbic acid. The objective of the present study was to prepare nutritionally enhanced ice creams by the incorporation of soy milk, watermelon seeds milk and guava pulp and evaluation of their acceptability and nourishing potential. Total six different types of ice creams were prepared from soy milk, watermelon seed's milk as whole and their blends with or without addition of guava pulp. At 9-point Hedonic scale products were evaluated for their appearance, flavor, mouth feel and overall acceptability in which most of the ice creams were liked moderately to very much and one ice cream were most acceptable, i.e., blended milk (50% soy milk and watermelon seed milk) ice cream with guava pulp. The nutritional analysis of most acceptable ice creams indicated that protein and fat value was found to be excellent and iron as well as vitamin C content were also found in good amount in comparison to standard cow's milk ice cream. Thus, these ice creams would be highly nutritious and acceptable by the population.

Key words: Ice cream, protein, guava, proximate, soy milk, India

INTRODUCTION

Ice cream is a delicious and nutritious frozen dairy dessert with high calorie food value (Khillari *et al*., 2007). Ice cream is a frozen dairy product made by freezing a mix with agitation to incorporate air and ensure uniformity of consistency (Arbuckle, 1986). The composition of ice cream varies depending upon the ingredients used in its preparation. The percentage composition of a good ice cream is milk fat 12%; milk solids-not-fat; sugar 15; stabilizer 0.2; emulsifier 6.2 (Manay and Shadaksharaswamy, 1987). It is an important supplement to the normal diet, especially for children and other age groups. But it is treated as a junk food and deleterious for heart patients due to high calorie and cholesterol (Minnhas *et al*., 2000). Ice cream could be made more nutritious and health beneficial by adding fruits and other protein rich ingredients. For this purpose, bovine milk in traditional ice creams could be replaced with other milk such as soy milk, watermelon seeds milk and vitamin C rich pineapple. The soybean seeds contain 13-25% oil, 30-50% protein and 14-24% carbohydrates. The major fatty acids are linoleic acid (55%) followed by oleic acid (21%), palmitic acid (9%), stearic acid (6%) and other fatty acids (9%). The ratio of polyunsaturated fatty acid to saturated fatty acid is (p/s ratio) 82:18. Soy protein contains all the essential amino acids, most which are present in amount that closely match with those required for humans or animals and protein having digestibility of about 92% which matches with animal protein such as egg white and casein (Feneslav and Schrezemeir, 2000). Soy milk is nutritious and is considered as a cost effective source of energy and protein, it also has a great potential to solve the problem of protein energy malnutrition in India and many other developing countries. WHO has recommended soy milk as a supplement of bovine milk. Its protein and oil contents are not only adequate but also rated as best in quality too. Because of high proportion of unsaturated fatty acids such as linoleic and linolenic acids, fat considered as highly healthful oil. Soy milk does not contain cholesterol and has been successfully utilized for the preparation of indigenous sweets (Biswas *et al*., 2002). Soy milk can be effectively used for supplementing cereal based products because of its amino acid pattern and has a great potential as food not only because of its high protein and energy contents but also due to the fact that it is a good source of vitamin and minerals (Khetarpaul and Goyal, 2008). Soy based diets are becoming popular due to neutraceutical benefits that suit to lactose intolerant, hypercholesterolemic, diabetic,

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anemic people and lactating mothers or post-menopausal women also (Kumar *et al*., 2001) and could be adopted as a substitute for milk in the parts of the world where milk production is low and dairy products prices are exorbitant (Nsofor and Anyanwu, 1992). In India, per capita availability of milk is only 263 g day^{-1} in 2009-2010 (http://www.nddb.org/statistics/milkproduction.html). So, soy milk has utility worldwide as a low cost, cholesterol free and lactose free alternative to concentrated cow's milk (Nsofor and Osuji, 1997). On the other hand, Melon seeds (*Cucurbis melo*), another valuable non-conventional food stuff, contains 50% fat, 28% protein, 2-7% fibre, 3.6% ash and 8.2% carbohydrate (Oyenuga and Fetuga, 1975). Watermelon seeds have similar fatty acids among palmitic acid, stearic acid, oleic acid, linoleic acid together constituted >80% of fatty acid content of oil (Bhatia *et al*., 1977). The seeds are also rich in arginine, tryptophan, methionine, vitamins B1, B2 and minerals such as calcium, magnesium, potassium, iron, zinc, sulphur and phosphorous (Akubor, 1998). The seeds are a rich source of enzymes, particularly urease and are considered as a diuretic and beneficial in chronic or acute eczema (Teotia and Ramakrishna, 1984). These two seeds milk can be used to prepare ice creams by incorporating them in different ratio with guava pulp. Guava has excellent digestive and nutritive value, pleasant flavor, high palatability and availability in abundance at moderate price (Sandhu *et al*., 2001). It is a rich source of certain minerals like calcium, phosphorus and iron which are necessary for human health (Agrawal *et al*., 2002). The pulp and the peel of the guava are a remarkable source of natural anti-oxidants and AODF (Anti-Oxidant Dietary Fiber), a combination of the properties of anti-oxidants and dietary fiber from a single source (Marquina *et al*., 2008). Lycopene is a potent anti-oxidant known for its protective action against prostate cancer and is found in guavas. In addition to lycopene, guavas are also an excellent source of beta-carotene and vitamin C with 228 mg/100 g of vitamin C as opposed to 53 mg/100 g in oranges (Chandrika *et al*., 2009). Guaijaverin, a flavanoid compound present in guavas inhibits the growth of Streptococcus mutans which is considered to be a pathogen for dental caries (Prabu *et al*., 2006).

Thus, the challenge was to develop a delicious and highly nutritious acceptable ice cream from soybean seeds milk, watermelon seeds milk and also with the addition of guava pulp with following objectives. To prepare the soybean and watermelon seeds milk and to evaluate their proximate composition:

- To develop nutritionally enhanced ice creams by the incorporation of soybean seeds milk, watermelon seeds milk and guava pulp
- To evaluate the acceptability of the prepared ice creams through sensory evaluation methods
- To conduct nutritional evaluation of the prepared ice creams by using standardized methods

MATERIALS AND METHODS

Procurement of seeds: Soybean and watermelon seeds used in this study were procured from Krishi Vigyan Kentra (KVK), Banasthali University and a retail shop, Jaipur city, Rajasthan, respectively. While other materials were procured from market of Banasthali University.

Development and standardization of milk: Soybean and watermelon seed milk was prepared according to the procedure described by Chakarbarti and Gangopadhyay (1990). Preparation process involved the cleaning and dehulling of seeds.

For preparation of seed's milk, seeds (100 g) were soaked in water containing 1% sodium hydroxide over night at a room temperature in the ratio of 1:4 (w/v). After soaking husks were removed by rubbing with hands. Then soaked seeds were blanched for 15 min in boiling water. Seeds were taken out and remaining water was drained out. After that 400 mL of water was added of seeds and blended in a grinder. The resulting suspension was then filtered through a double layer muslin cloth. At last cane sugar at 6% (w/v) was added in seed milk and boiled for 5 min with constant stirring.

Nutrient analysis: Nutrient analysis was done for bovine milk, developed milk (soy milk and watermelon seeds milk) and the most acceptable ice creams by sensory evaluation using standard methods of AOAC (1980). Moisture content was determined by drying of sample in an oven at 80°C for 24 h and is expressed in percentage basis. Crude protein was determined by estimating nitrogen content using 6.25 as the conversion factor by Kelplus Pelican Equipment. Fat and ash contents were determined by Gerber Method and dry ashing methods, respectively. Iron was estimated by Wong's Method as given by Ranganna (1986) and vitamin C by titrametric estimation following the AOAC Methods.

Food product development: Six variant of ice creams were prepared by incorporating soy milk and watermelon seeds milk alone and blended form with and without addition of guava pulp (Standard milk ice cream, soya milk ice cream, 50% soya milk and 50% watermelon milk ice cream, soya milk ice cream with guava pulp, 50% soya milk and 50% watermelon milk ice cream with guava pulp) to modify standard ice cream and their composition is shown in Table 1. Out of which Watermelon seed Milk Ice cream

Table 1: Composition of standard ice cream and their variants

Ingredients	S	A	B	C	D
Bovine milk (mL)	100.00	-	-	-	-
Soy milk (mL)	-	100.00	50.00	100.00	50.00
Watermelon seeds milk (mL)	-	-	50.00	-	50.00
Guava pulp (g)	-	-	-	50.00	50.00
Sugar (g)	20.00	20.00	20.00	20.00	20.00
GMS (g)	0.75	0.75	0.75	0.75	0.75
CMC (g)	0.25	0.25	0.25	0.25	0.25
Corn flour (g)	2.00	2.00	2.00	2.00	2.00
Cream (g)	25.00	25.00	25.00	25.00	25.00
Guava essence (drops)	2-3.00	2-3.00	2-3.00	2-3.00	2-3.00

S: Standard milk ice cream; A: Soy milk ice cream; B: 50% soy milk and 50% watermelon milk ice cream; D: Soya milk ice cream with guava pulp; E: 50% soy milk and 50% watermelon milk ice cream with guava pulp

(WMI) and 100% Watermelon seeds milk with 50 g guava Pulp Ice cream (WPI) was technically unsuccessful. Therefore, 4 variants of ice creams excluding standards were developed.

Sensory evaluation: The sensory evaluation of recipes was carried out using 9-point Hedonic rating scale by 15 semi-trained panel members selected by triangle difference test. Appearance, flavor, mouth feel and overall acceptability were considered for evaluation (Stone and Sidel, 2004).

Statistical analysis: The data were processed for the analysis of mean and standard deviation by Microsoft Office Excel.

RESULTS AND DISCUSSION

Proximate composition of soya and watermelon milk moisture content: The results of the moisture content are shown in Table 2. The moisture contents of Bovine Milk (BM), Soy Milk (SM) and Watermelon Seeds Milk (WSM) were 87.05, 87.44 and 81.33%, respectively. The moisture content of watermelon seeds was found to be slightly lower than bovine milk whereas that of soy milk was slightly higher than bovine milk.

Protein content: The results reveals that the protein content of soy milk seed milk was found 4.23 g/100 g which was higher than the standard cow's milk that contain 3.50 g/100 g protein content. There was a significant difference in protein content of soy milk seed milk in comparison to standard cow's milk.

Since soybean seeds contain 40% protein and its protein and oil content are not only high in quantity but also rated as best in quality too, all the essential amino acids (O'kennedy *et al*., 1979).

Fat content: The results show that fat content of soy milk was 3.20 g/100 g which was slightly lower than the

Table 2: Proximate composition of soy milk and watermelon seeds milk[a]

Proximate composition	Standard milk	Soy milk	Watermelon seeds milk
Moisture (%)	87.05±0.40	87.44±0.90	81.33±0.36
Protein (g/100)	3.50±0.20	4.23±0.41	2.80±0.20
Fat (g/100)	4.10±0.32	3.20±0.30	8.50±0.43
Ash (g/100)	0.72±0.03	0.84±0.04	0.88±0.02

[a]Mean value of a three triplicate samples±SD

Table 3: Mean scores of sensory attributes of ice creams[b]

Attributes	S	A	B	C	D
Appearance	8.84±0.37	6.88±0.83	6.80±0.81	7.84±0.65	8.44±0.50
Flavor	8.72±0.45	6.76±1.05	6.80±0.76	7.08±0.86	8.40±0.64
Mouth feel	8.80±0.40	6.36±1.11	7.92±0.40	8.48±0.56	8.40±0.50
Overall acceptability	8.84±0.37	6.80±0.86	6.96±0.88	7.68±0.55	8.56±0.50

S, A, B, C, D as in Table 1; [b]Mean value of 15 panelist±SD

Ash content: Ash content of soy milk and watermelon seeds milk were 0.84 and 0.88 g/100 g, respectively found to be higher in comparison to standard cow's milk which contains 0.72 g/100 g ash. This is because soybean is a good source of iron, potassium, calcium, magnesium and phosphorus with water soluble and B complex vitamins (Gupta, 2008) and watermelon seeds are also rich in minerals such as calcium, magnesium, potassium, iron, zinc, sulphur and phosphorus (Akubor, 1998).

Sensory analysis of ice cream: Sensory analysis results show (Table 3) that the mean scores of the 100% soy milk ice cream (A) made by soy milk was found slightly varied at all attributes like appearance, flavor, mouth feel and overall acceptability as compared to 100% bovine milk Standard ice cream (S). A total of 100% soy milk ice cream (A) was liked slightly to moderately (6.36-6.80).

The results of ice cream (B) made by 50% soy milk and watermelon seeds milk was liked slightly to liked very much in attributes like appearance, flavor and overall acceptability (6.80-6.96) whereas in mouth feel attribute it was liked moderately (7.92) as compared to standard ice cream.

The mean scores of sensory evaluation of ice cream made of 100% soy milk with 50 g guava pulp (C) was in the range of liked moderately to liked very much in attributes like appearance, flavor and mouth feel (7.08-7.84) whereas in mouth feel attribute it was liked very much (8.48). Ice cream (D) made of 50% soy milk and 50% watermelon seeds milk with 50 g guava pulp was in the ranges of liked very much to liked extremely in all attributes like appearance, flavor, mouth feel and overall acceptability (8.40-8.56) as compared to bovine standard ice cream (S).

Therefore, it can be seen from the results of the mean scores of the sensory evaluation that ice cream (D) made of 50% soy milk and 50% watermelon seeds milk with 50 g guava pulp is the most acceptable ice cream and the

Table 4: Proximate composition of two most acceptable ice creams[c]

Nutrient composition	S	D
Moisture (g/100 g)	89.16	80.10
Protein (g/100 g)	3.83	11.12
Fat (g/100 g)	5.83	7.26
Ash (g/100 g)	1.40	2.30
Iron (mg/100 g)	1.27	1.56
Vitamin C (mg/100 g)	0.00	89.92

S: Standard cow's milk ice cream; D: 50% soy milk and 50% watermelon seed milk ice cream with guava pulp; [c]Mean value of a three triplicate samples±SD

standard milk ice cream got highest scores among the all samples and liked extremely by the semi trained panel members on 9-point Hedonic scale.

Nutrient analysis of ice creams: Four variants ice creams were developed excluding standard ice cream out of which (D) ice cream made of 50% soy milk and 50% watermelon seeds milk with 50 g guava pulp ice cream was the most acceptable in all attributes like appearance, flavor, mouth feel and overall acceptability. Therefore, the proximate composition of standard ice cream (100% cow milk) and most acceptable ice cream, i.e., blended milk ice cream with guava pulp-D (50% soy milk and 50% pumpkin seed milk) were analyzed and shown in Table 4.

Moisture: The moisture content of most acceptable ice cream was shown in Table 4. The moisture content of bovine milk Standard (S) ice cream and 50% soy milk with 50% watermelon seeds milk and guava pulp (D) ice cream were 89.16 and 80.10%, respectively. Thus moisture content of sample D was found to be lower than sample S.

Protein: The protein content of bovine milk Standard (S) ice cream was lower than 50% soy milk with 50%watermelon seeds milk and guava pulp (D) ice cream, i.e., 3.83 and 11.12%, respectively. High protein content of ice cream (D) is due to high protein content found in both soy milk as well as watermelon seed milk.

Fat: In addition to their nutritional and functional value, fats have other uses which derive principally from their distinct physical properties. They contribute to the tenderness, flavor, color and texture of food product. The results of fat content have been shown in Table 4. The fat content of bovine milk Standard (S) ice cream and 50% soy milk with 50% watermelon seeds milk and guava pulp (D) ice cream were 5.83 and 7.26%, respectively. This shows that fat content of sample D was found to be higher than sample S. This may due the reason that soymilk and pumpkin seed milk are a good source of unsaturated fatty acids which are helpful in preventing cardiovascular diseases.

Ash: Ash is an indication of its mineral status, the higher the mineral content, higher would be ash content of the product. The ash content of bovine milk Standard (S) ice cream and 50% soy milk with 50% watermelon seeds milk and guava pulp (D) ice cream were 1.4 and 2.30%, respectively. The ash content of sample D scored highest value than sample S.

Iron: The iron content of bovine milk Standard (S) ice cream and 50% soy milk with 50% watermelon seeds milk and guava pulp (D) ice cream were 1.27 and 1.56%, respectively. The iron content of sample D was found to be higher than sample S.

Vitamin C: Standard cow's milk ice cream contain negligible amount of vitamin C content. The vitamin C content of bovine milk standard (S) ice cream and 50% soy milk with 50% watermelon seeds milk and guava pulp (D) ice cream were 0 and 89.92%, respectively. This reveals that vitamin C content of D sample was found to be higher than sample S.

CONCLUSION

Four variants of nutritious ice creams were prepared from soy milk, watermelon seed milk and guava pulp. This effort was done to ensure the quality of nourishment to the masses facing economic and availability constraints. Mean scores of overall acceptability of ice creams reveals that among all samples of ice creams, blended milk ice cream (50% soy milk and 50% watermelon seed milk) with guava pulp-D were most acceptable at 9-point Hedonic scale.

Nutrient analysis of most acceptable ice creams indicated that protein and fat content were found to be excellent as compared to standard ice cream and iron and vitamin C were also found to be high. Ice cream made out of soy milk and watermelon seeds milk can be easily used in community as these are highly acceptable and free from beany flavor. Moreover, protein content is high among these ice creams as compared to bovine milk standard ice cream. The results of the present study goes to emphasis that the ice creams prepared were not only rich in protein but also in mineral such as iron and vitamin C. Thus, efforts can be put to develop products by using other fruits.

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