PROCESSING OF HEALTHY ICE MILK

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Abstract

The plant oil from safflower as a source of essential linoleic fatty acid, antioxidant and anticancer used to process functional ice milk. Chemical composition of safflower extract and physico-chemical properties of ice milk (containing 10, 20, 30, 40 and 50% safflower extract) mixes were estimated. Sensory evaluation of the resultant ice milk was also determined. The results showed that melting resistance increased as the substitution level increased. On the other hand, overrun decreased as the substitution level increased. The results showed that the maximum substitution ratio with safflower successfully was up to30%.

Key words: Safflower – ice milk - Essential linoleic fatty acids– healthy food – physico-chemical properties – melting resistance and functional foods.

INTRODUCTION

Ice cream is a popular frozen milk product made from varying mixtures of cream and milk, sweeteners, flavorings and air. The air is beaten into the milk mixture during freezing, causes the final product light and maleable. Ice cream is a frozen dairy product made by freezing a mix with agitation to incorporate air and ensure to be homogenous and acceptable consistency (Arbuckle, 1986). The complex physical structure of ice cream presents a challenge for food chemists. It could be stated, overall goal of designing the ice cream is to incorporate several different air bubbles, ice crystals and fat globules into an aqueous phase in the smallest size and in the greatest numbers possible. The ingredients used to supply this composition of ice cream include a concentrated source of milk fat, usually cream or butter, a concentrated source of the milk solids-not-fat component, usually evaporated milk or milk powder, sugar including sucrose and "glucose solids", a product derived from the partial hydrolysis of the corn starch component in corn syrup and milk. Ingredients are selected by processor, on the basses of fine quality, availability and cost.

As a general trend, in the world today, vegetable oils are used partially or totally as a substitute for animal fat. The partial replacement of milk solids not fat with plant oil or fat has been extensively investigated because of its economical and nutritional status. Consumer trends in relationship between diet and health, increases the demand of functional foods, which are foods or dietary components that may provide a health benefit beyond basic nutrition. Ice milk has become one of the most

acceptable desserts world wide. Several sources of non-dairy materials have been investigated to replace partially mix ingredients in ice cream industry, such as soy flour (Hammad et al., 1985), soy milk (Saleem et al., 1989) barley, (Abd-El-Rahman 2003), chufa milk (Abd-El-Rahman and Assem 2004) and oil seed protein concentrates (Salama et al., 2007).

Safflower (Kortom) is commercially available and it is one of the most economic sources of the essential linoliec fatty acid. Studies confirmed effects of safflower oil in folk medicine as-antioxidant and anti-cancer. Moreover, safflower oil relief cough, bronchial asthma, expectorant and useful in atherosclerosis treatment, relif stomach pains and it can be used also as ointment for vitiligo, chroma, arthritis and rheumatic pains (Khatab et al., 1998).

Limited studies concerning safflower in dairy field were received from literature. Tong et al., (1984) used safflower oil and milk fat blends in ice creams, while Kim et al., (2004) studied the effects of safflower seeds (SFS) yoghurt on bone health in an Osteoporosis model of in rats. Abd-El-Rahman and Salama (2008) prepared yoghurt-like fermented product with partial safflower extract substitution for milk solids.

For all the above mentioned, processing healthy ice milk by using safflower are investigated in the present study.

MATERIALS AND METHODS

Materials

- Safflower (*Carthomus tinctorius*) was obtained from field Crops Research Institute, A.R.C., Giza. Fresh skim buffaloes' milk and cream were obtained from Faculty of Agriculture, Cairo University, Egypt.
- Skim milk powder, sugar and vanilla were purchased from local market. Gelatin was purchased from the Egyptian Company for Milk products and additives.

Methods

Germination of safflower seeds (*Carthamus tinctorius*) was soaked until the rootlet appears (1m). water was added to the germinated seeds, at a water ratio of 3:1 and blended using light speed blender then drained muslin cloth to remove fibers. The filtrate was considered as the safflower extract.

Preparation of ice milk mixes

Three replicates of ice milk mixes (1kg each) were prepared using germinated safflower extracts as a substitute for fresh skim buffaloe's milk at the levels, 10, 20, 30, 40 and 50%.

All mixes were standardized to contain 6% fat and 11% solids not fat (S.N.F) using fresh cream and skim milk powder. Fifteen percent sugar, and 0.3%

stabilizer&emulsifier were added. All mixes were heat treated at 85°C for 5min., then cooled to 5°C and 0.1% vanilla was added. There after, the mixes were aged at 6°C for 24hr before freezing as reported by Arbuckle (1986) using hard ice cream machine (Taylor Co. USA). The resultant ice milk was filled into PVC cups (cap. 60 ml) covered and hardened in deep freezer at -16°C) for 24 hours before analysis. The composition of six different ice milk mixes are shown in Table (1).

Table 1. Formula of ice milk mix made by substitution of milk solids non fat (MSNF) with different levels of safflower extract.

Ingredients	Control	T_1	T_2	T_3	T_4	T_5
Fresh skimmed milk	0.653	0.612	0.536	0.472	0.404	0.340
Skimmed milk powder	0.0445	0.044	0.044	0.044	0.044	0.0535
Safflower extract	--	0.068	0.134	0.202	0.270	0.340
Cream (40% fat)	0.15	0.143	0.140	0.134	0.130	0.124
Sugar	0.15	0.15	0.15	0.15	0.15	0.15
Vanilla	0.001	0.001	0.001	0.001	0.001	0.001
Emulsifier&stabilizer	0.003	0.003	0.003	0.003	0.003	0.003
Total (weight of mix kg)	1.00	1.00	1.00	1.00	1.00	1.00

Chemical analysis

Safflower extracts, fresh skimmed milk, skimmed milks powder and cream were analyzed for their total solids (TS), fat, total protein and ash according to the methods outlined A.O.A.C (1995). Total carbohydrates were calculated by differences.

The prepared mixes and ice milk were analyzed for their titratable acidity, pH value as reported by Ling (1963). Specific gravity was determined at 20°C using pycenometer as described by (Winton, 1958), weight per gallon (Burke, 1947). Melting resistance of the resultant ice milk was examined according to Reid and Painter (1933). The overrun of the resultant ice milk was examined according to Arbuckle (1986). Viscosity was determined using a viscometer LV model DV-IIL according to Johnson et al., (1995). The freezing point for the mixes was tested as in Marshall et al., (2003).

Linoleic acid content of safflower extracts and ice milk mixes were measured using GLC technique under the following condition:

-Preparation of fatty acids methyl ester: In 5-ml screw-top test tube weight approximately 0.1gm of the oil sample. Add 2ml of hexane, and shake. Add 0.2 ml of 2 N methanolic potassium hydroxide solution, and shake vigorously for 30 seconds. Leave to stratify until the upper solution becomes clear. Decant the upper layer containing the methyl esters. The hexane solution is suitable for injection in to the gas chromatograph. It is advisable to keep the solution in the refrigerator until gas

chromatographic analysis. Storage of the solution for more than 12 hours is not recommended.

- Identification of fatty acid methyl ester s by GLC technique

Agilent 6890 series GC apparatus provided with a DB-23 column (60m × 0.32mm × 0.25 µm). Fatty acids results after the previous procedures steps were transformed in to methyl esters and directly injected in to the GC. Carrier gas was N2 with flow rate of 2.2 ml / min, splitting ratio of 1:80. The injector temperature was 250 °C and that of FID detector was 270 °C. The temperature setting was as follows: 150 °C to 225 °C at 50 °C/min, and then held at 225 °C for 20 min

Sensory evaluation

The sensory properties of each patch ice milk according to Nelson and Troat (1951).

RESULTS AND DISCUSSION

Chemical analyses of raw dairy ingredients used for ice milk making

(Table 2) indicated that total solids, fat, total protein, ash and total carbohydrates of safflower extract which is similar to cow milks. Safflower is higher in total protein which record (4.20) and less than that of in carbohydrate which scroll 3.43 comparatively to cows milk.

Properties of ice milk mixes

The results in Table (3) show that the titratable acidity is slightly increased as the substitution level increased with germinated safflower extract. On the other hand, pH value of ice milk mixes of all treatments was opposite values in titratable acidity. These results may be due to the air condition of the germination of safflower seeds. Results agreed with those obtained by Abd El-Rahman and Salama (2008).

Viscosity, specific gravity and weight per gallon of ice milk mixes of all treatments were slightly increased as the substitution level increased. These results were contrary to data obtained from Gonzalez et al. (2003) who found that the higher content of unsaturated fatty acids (Oleic and Linoleic) than the control milk fat resulted in decreasing the viscosity of the resultant ice cream mix. On the other hand, the freezing point of the all mixes behaved opposite of these trend with increasing the substitution levels. These results, were in agreement with Abd El-Rahman (2003).

Properties of processed ice milk

Data presented in Table (4) show the properties of the resultant ice milk. It is clear that the titratable acidity and pH value of ice milk had the same values and trend of ice milks mixes. The overrun percentage was decreased with increasing the substitution level of germinated safflower extract. These results may be due to the

natural of germinated safflower protein as compared to milk protein. The ice milk without safflower extract (control) had an overrun of 78.88% while it was 73.4%, 63.55%, 59.92%, 50.83% and 49.33% for mixes with 10, 20, 30, 40 and 50% respectively. As show in Table (4), melting resistance of ice milk samples increased as the substitution level increased as it completed melted after 60 in 30°C at all levels of substitution.

Table (5) indicated that replacement of milk fat with plant oil (safflower) in ice milk values changed markedly the fatty acids profile of ice milk fat. The C18:2 content of ice milk varied from 13.79% to 28.02% in treatments compared with the control (11.19%). These variations can be attributed to utilization of safflower as a source of essential linoleic fatty acid. Where, treatments (T4&T5) which were characterized by high C18:1 and C18:2 contents, increased in C18:1 and C18:2 was attributed to increase of the substitution level of safflower extract.

Scores for body and texture, flavour, melting properties and appearance are presented in (Table 6). In general, the control treatment showed the highest total scores (94 out of 100 point) among all treatments. Safflower ice milk formula produced with adding safflower exhibited slight creamy color which was preferable to panelists. Increasing the safflower ratio enhanced the coulur to be more preferable to judges. The quality scores were slightly decreased as the substitution level increased with safflower extract at which the total scores arrived 73.5 in treatment (5) at substitution level 50% percent safflower extract.

Finally, it could be concluded that the ice milk with safflower extract up to 30% is recommended for manufacturing functional ice milk with high quality.

Table 2. The gross composition of raw dairy ingredients used for ice milk making (g/100g) Formula of ice milk mix made by substitution of milk solids not fat (MSNF) with different levels of safflower extract.

Ingredients	TS	Fat	T.P	Ash	Total carbohydrate
Safflower	11.50	3.00	4.20	0.87	3.43
Fresh skimmed	9.05	0.10	3.41	0.80	4.74
Skimmed milk	97.00	0.50	35.08	8.01	53.42
Cream (40%	48.02	40.00	3.50	0.71	3.81

Table 3. Acidity, pH value and some physical properties of ice milk mixes made with safflower extract.

Property	Control	T_1	T_2	T_3	T_4	T_5
Acidity	0.13	0.14	0.15	0.17	0.18	0.19
pH value	6.39	6.35	6.26	6.13	6.05	6.00
Viscosity	125	180	215	330	420	560
Specific	1.0900	1.1029	1.1129	1.1271	1.1975	1.2814
Weight per	9.0965	9.2037	9.2870	9.4056	9.9930	10.6930
Freezing	- 1.11	- 1.51	- 1.66	- 2.22	- 2.92	- 3.91

T_1 : 10% safflower extract T_2 : 20% safflower extract

T_3 : 30% safflower extract T_4 : 40% safflower extract

T_5 : 50% safflower extract

Table 4. Acidity, pH value, melting resistance and overrun of the resultant ice milk made with safflower extract.

Property	Control	T_1	T_2	T_3	T_4	T_5
Acidity	0.20	0.21	0.23	0.30	0.31	0.36
pH value	6.50	6.49	6.38	6.31	6.17	6.16
Melting resistance as loss% at	51.57	2.20	9.74	6.40	6.70	2.31
after 30 min	93.09	5.04	26.85	23.18	13.7	10.11
after 45 min	100	79.54	75.24	68.75	61.12	58.11
after 60 min	---	100	100	100	100	100
Overrun (%)	78.88	73.40	63.55	59.92	50.83	49.33

Table 5. Essential fatty acids distribution of resultant ice milk samples made with safflawer : data expressed as percentage of total fatty acids (% FA).

Compound	Control	T_2 (20%)	T_4 (40%)	T_5 (50%)
Palmitic acid (C16:0)	32.42	12.65	25.25	22.87
Stearic acid (C18:0)	4.76	6.92	10.59	10.87
Oleic acid (C18:1)	19.65	46.23	49.70	61.16
Linoleic acid (C18:2)	11.19	13.97	15.86	28.02

Table 6. Organoleptic scores of ice milk made with safflower extract.

Property	Control	T_1	T_2	T_3	T_4	T_5
Flavour (50)	46.70	44.20	44.00	43.60	40.36	35.10
Body&texture (40)	38.50	37.00	36.00	35.01	30.32	30.40
Melting quality (10)	9.50	9.00	9.00	8.50	8.15	8.00
Total (100)	94.70	90.20	89.00	87.01	78.83	73.5

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تصنيع مثلج لبنى صحى

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معهد تكنولوجيا الأغذية – مركز البحوث الزراعية – الجيزة

تهدف الدراسة إلى إنتاج مثلج لبنى صحي باستخدام القرطم والذي يعد من أكبر المصادر الاقتصادية للحامض الدهنى الاساسى اللينوليك ومضاد للأكسدة ومضاد للسرطان مما يجعلة غذاء وظيفي حيث استخدم المستخلص المائي للقرطم المنبت كبديل للبن الفرز الجاموسى الطازج في إنتاج المثلج اللبني بمستويات استبدال صفر ، ١٠ ، ٢٠ ، ٣٠ ، ٤٠ ، ٥٠% ولقد أظهرت النتائج تناقص% للريع بتزايد نسب الاستبدال كما تزايدت المقاومة للانصهار بإستمرار تزايد نسب الاستبدال كما أوضح التحكيم الحسي أنه يمكن استخدام المستخلص المائي للقرطم المنبت كبديل للبن الفرز الجاموسى بنجاح حتى نسب استبدال ٣٠%.