Annals Agric. Sci., Ain Shams Univ., Cairo, 50(1), 161-168, 2005

POTENTIAL HEALTHY FUNCTIONAL ICE CREAM MANUFACTURE WITH PUMPKIN FRUIT (*CUCURBITA pepo*)

[12]

Hassan[1], Z.M.R.

ABSTRACT

An attempt was made to produce functional ice cream with 10, 20, 30 and 40% of cooked or roasted pumpkin fruits as a source of dietary fibers. Changes in specific gravity, freezing point, viscosity, weight per gallon in kilogram, titratable acidity, protein stability of ice cream mix as well as the overrun, melting resistance and sensory evaluation of the resultant ice cream were investigated. Increasing the pumpkin added showed an increase in the acidity, specific gravity and weight per gallon in kilogram of ice cream mixes as well as a decrease in freezing point and protein stability of the mixes. The apparent viscosity in ice cream mixes improved with increased amount of pumpkin. Increasing the amount of pumpkin added decreased the overrun of ice cream. Adding pumpkin increased both melting resistance and specific gravity of ice cream. Ice cream samples containing 30% cooked or roasted pumpkin (0.58% fibers) were organoleptically superior, followed by that of 20 % cooked or roasted pumpkin (0.34 % fibers). The obtained results reveled that ice cream containing 30% cooked or roasted pumpkin had the highest organoleptic score and recommended for manufacturing functional pumpkin ice cream with high fibers content.

Key words: Dietary Fibers, Pumpkin fruit, Functional ice cream

INTRODUCTION

Consumer interest in the relationship between diet and health increases the demand for information on functional foods. Functional foods are foods or dietary components that may provide a health benefit beyond basic nutrition. You can take greater control of your health through the food choices you make, knowing that some foods provide specific health benefits. Examples include some components from fruits and vegetables to fortify or enhance foods. Ice cream has become one of the most acceptable desserts in the Egyptian market. Incorporation of fruit pulp and vegetable gum such as guar gum during the manufacture of yoghurt and cultured products may offer a potential source of dietary fibers, **(Deeth and Tamime, 1981)**. The practice of using various sources of fi-

1- Food Science Department, Faculty of Agriculture, Ain Shams University, Shoubra El-Kheima, Cairo, Egypt.

(Received January 11, 2005)
(Accepted February 7, 2005)

bers, i.e. crisps cereal pieces (**Kaufman *et al* 1990**) and wheat grains (**Hamzawi and Kamaly, 1992**) as an important dietary constituent in yoghurt has been reported. It is composed of a combination of milk products, flavoring materials, stabilizer and sugar. Several resources of non-milk materials have been researched to replace partially mix ingredient in ice cream industry such as soy flour (**Hammad *et al* 1985**), soymilk (**Saleem *et al* 1989**), rice and potato pulp (**Das *et al* 1989 and Metwally, 1994**). The Pumpkin is among the more important plant families that supply human with caroteniоids, dietary fibers and carbohydrates. The intake of caroteniods as potent antioxidants appear to be associated with better health, reduction of some types of cancer, cardiovascular disease and macular degeneration (**Olson, 1986 and Hughes, 1995**). Dietary fibers are defined as the remnants of vegetable cell walls, which are not hydrolyzed, by alimentary enzymes. Dietary fibers have long been considered as an insignificant part of the human diet because it is believed to contribute little nutritionally. However, there is current evidence, although primarily epidemiological, that dietary fibers may have a direct effect upon some human biochemical and physiological processes. A lower dietary fibers intake is reportedly associated with several disorders of the human body including diverticular disease and cancer of the colon, constipation, heart disease, diabetes and other diseases of the gastrointestinal tract (**Cummings and Englyst, 1991**). One method suggested for incorporating of fibers into diet is to supplement certain food products with fibrous materials (**Prakongpan *et al* 2002**). That material used or proposed for this purpose may alter various properties of food products including appearance, flavor and texture (**Vratania and Zabik 1978**). The structure and surface activity contributed by the water insoluble fibers combined with the gel-forming viscous properties of the water soluble fiber network may affect the properties of the resultant ice cream.

Therefor, the present investigation was initiated to study the possibilities of utilizing pumpkin fruits as potential source of healthy functional ingredients such as dietary fibers, as well as stabilizing and coloring materials in preparing a new functional and healthy ice cream.

MATERIAL AND METHODS

Materials

Fresh buffalo's milk was obtained from the herd of Faculty of Agriculture, Ain Shams University and used for the ice cream making. Pumpkin fruits (*Cucurbita pepo*) were obtained from local market. Skim milk powder (SMP) made in USA was obtained from Misr for Milk and Food Co., Cairo, Egypt. Commercial grade cane sugar was purchased from sugar and integrated industries company, Giza, Cairo. Carboxymethyl cellulose (CMC) was used as a stabilizer. Vanilla was used as flavouring agent.

Preparation of pumpkin paste

The pumpkin (*Cucurbita pepo*) fruits were washed, manually peeled and uniformly sliced in cubic form. The aforementioned ingredient was divided into two portions, the first one was steam cooked under atmospheric pressure for 20 min, then cooled to room temperature. The second portion was roasted in electric oven at 180°C for 15 min. Both portions were mixed well in a laboratory type blender (Braun, Germany) and stored at −18°C until used. The cooked pumpkin had the values of 89.00, 1.12, 7.45, 0.62, and 1.63 % for moisture, protein, carbohydrate, ash, and fiber, respectively. The corresponding values for roasted pumpkin were 87.00, 1.33, 8.33, 0.90, and 1.84 % for the same parameters in the same order.

Preparation of ice cream

Ice cream treatments were prepared from the prementioned ingredients with quantities shown in Table (1). The control mix was standardized to contain 6% fat, 12% milk solid not fat (MSNF), 15% sugar, 0.25% CMC and 0.01%vanilla powder. The pumpkin was added at levels of 10, 20, 30, and 40 % to the mix as shown in Table (1). Mixes were heat treated to 80±1°C, then rapidly cooled to 5±1°C and aged at the same temperature for 4 hr. After ageing, vanilla was added and the mixes were frozen in horizontal batch freezer (Taylor Co. USA). The frozen ice cream was filled in plastic cups (120 ml) and hardened at -26°C for 24 hrs. before analyses. All treatments were of three replicates.

Table 1. The ice cream formulas using different levels of cooked and roasted pumpkin (g|kg)

Ingredients	Control	Cooked pumpkin				Roasted pumpkin			
		I	II	III	IV	I	II	III	IV
Cream (50%fat)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Buffalo skim milk	779.7	669.5	559.3	449.0	341.6	669.5	559.3	449.0	341.6
Skim milk powder	55.8	66.0	76.2	86.5	96.4	66.0	76.2	86.5	96.4
Pumpkin paste	-	100	200	300	400	100	200	300	400
Sucrose	150	150	150	150	150	150	150	150	150
Carboxy methyl cellulose	2.5	2.5	2.5	2.5	-	2.5	2.5	2.5	-

Methods of analyses

Titratable acidity of mixes was determined according to **Richardson (1986)**. The protein stability was estimated as mentioned by **Arbuckle (1986)** and expressed as milliliters of ethanol 95 % necessary to form a slight turbidity. Specific gravity was determined at 20°C using pycenometer as described by **Winton (1958)**. Melting resistance of the resultant ice cream was examined according to **Reid and Painter (1933)** and the weight per gallon in kilogram was calculated as suggested by **Marshall *et al* (2003)**. The overrun in the resultant ice cream was examined according to **Sommer (1951)**. The freezing point for the mixes was tested as in **Marshall *et al* (2003)**. Apparent viscosity was determined using a coaxial rotational viscometer (Rheotest, type RV2, Pruefgreat, Medingen, Germany) at shear rates ranging from 1.8 to 1312 sec^{-1}. The measuring device (S1) was used with a sample volume of 30 ml per run. All samples were adjusted to 20±1°C before loading in the viscometer device. Apparent viscosity was calculated at shear rate of 48.6 sec^{-1}.

Sensory evaluation

Samples of ice cream after 24 hour hardening at -26°C were tempered to -8°C and organoleptically evaluated by a panel of 8 judges selected on the basis of their consistency in scoring. The samples scored for flavour (45), body & texture (30), melting property (15) and colour (10) as suggested by **Arbuckle (1986)**.

RESULTS AND DISCUSSION

Composition of pumpkin paste

It could be noticed from the premen-tioned composition of pumpkin paste that it contains measurable quantities carbohydrate and fibers, also the roasted pumpkin had higher ash content and lower moisture content when compared with the cooked pumpkin.

Mix properties

Table (2) shows some properties of the cooked and roasted pumpkin ice cream mixes. Titratable acidity increased with increasing amount of pumpkin added to the ice cream mix than the control one. The slight increase in acidity of mix with pumpkin may be due to the effect of pumpkin paste which had more ash content. These results are in agreement with **Marshall *et al* (2003)**, who reported that the titratable acidity of mixes increased when mineral salts were added. For the same reason, the protein stability in the mix showed also slight difference. The protein stability decreased with increasing pumpkin ratio in the ice cream mix (Table 2). It was found also from Table (2) that the addition of pumpkin increased the specific gravity. It could be noticed that the weight per gallon in kilogram of all mixes found to be closely related to their specific gravity. The tested apparent viscosity of ice cream mix with 10,20,30 and 40% cooked or roasted pumpkin is shown in Table (2). The results revealed that, increasing amounts of pumpkin increased the apparent viscosity of ice cream mixes. This may be due to the higher fiber contents in pumpkin, which is responsible for gel forming viscous, as well as particle size and high water holding capacity of fibers **(Vani and Zayas, 1995)**. These results are in agreement with the trend given by **Metwally (1994)**, who found that the addition of sweet potato to the ice cream mix increased its viscosity. The control treatment showed the highest freezing points among all the treatments (Table 2). The lowest freezing points in the treatments may be due to high ash content of ice cream with pumpkin compared with control treatment.

Resultant ice cream properties

The addition of pumpkin increased the specific gravity of all treated ice

Table 2. Properties of ice cream mixes containing different quantities of pumpkin

Properties	Control	Treatments (Pumpkin quantities)							
		Cooked pumpkin				Roasted pumpkin			
		I	II	III	IV	I	II	III	IV
Specific gravity	1.086	1.093	1.095	1.115	1.135	1.105	1.115	1.126	1.140
Weight per gallon in kg	4.12	4.14	4.15	4.22	4.30	4.18	4.22	4.26	4.32
Viscosity(cp)	35.57	27.13	38.83	44.11	48.32	28.22	41.33	46.23	50.22
Freezing point (°C)	-2.11	-2.10	-2.3	-2.5	-2.6	-2.10	-2.4	-2.5	-2.9
Protein stability*	8	8	7	7	6	8	7	7	6
Titratable acidity %	0.21	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24
Fiber %	-	0.26	0.34	0.58	0.74	0.29	0.49	0.61	0.82

* Expressed as milliters of ethanol 95% necessary to form a slight turbidity

cream than that of the control. Table (3) indicates that specific gravity and weight per gallon in kilogram of resultant ice cream with 40% pumpkin paste were highly increased in comparison with the control samples. This increase in the specific gravity depends on the formula components as well as mix ability to hold the air pulps and overrun percent in the resultant ice cream (**Marshall *et al* 2003).** Table (3) shows also that the quantity of pumpkin in mixes affected the overrun values. The ice cream without pumpkin (control) had an overrun of 60.12 % while it was 41.57 and 40.48 for mix with 30 % cooked or roasted pumpkin. The addition of pumpkin to the mix improved the viscosity but decreased the whipping abilities compared with the control. In general, as the viscosity increases, the resistance to melting and the smoothness of texture increases, but the rate of whipping decreases (**Marshall *et al* 2003**). The overrun percentage of the ice cream with 40 % pumpkin without stabilizer showed high viscosity as a result of stabilizing effect of pumpkin and this leds to low overrun of ice cream. Melting resistance of ice cream was expressed as the loss in weight percent of the initial weight of the tested samples (Table 3). The melting resistance of ice cream samples increased with increasing amount of different pumpkin added. The control ice cream and the ice cream with 10 % pumpkin showed lower melting resistant after 60 min. than the rest ice cream treatments with different pumpkin quantities. This may be due to their lower content of water holding constituents. However, the treatments with different quantities of pumpkin caused soggy body and low overrun. Sogginess in contributes to high melting resistance (**Arbukle, 1986**).

Table 3. Properties of ice cream containing different quantities of pumpkin

Properties	Control	Treatments (Pumpkin quantities)							
		Cooked pumpkin				Roasted pumpkin			
		I	II	III	IV	I	II	III	IV
Specific gravity	0.79	0.83	0.90	0.87	0.94	0.86	0.92	0.88	0.96
Weight per gallon in kg	2.94	3.14	3.40	3.29	3.55	3.25	3.48	3.33	3.63
Overrun %	60.12	53.91	43.43	41.57	31.20	52.59	42.51	40.48	30.33
Melting resistance (Loss% after)									
60 min	55	54	47	49	37	48	43	48	32
90 min	47	45	53	51	63	52	57	52	68

Sensory evaluation

Scores for body & texture, flavour, melting properties and colour are presented in Table 4. In general the control treatment showed the highest scores (97out of 100 point) among all treatments. It seemed that, the manufactured ice cream with 20% or 30% pumpkin ranked the highest scores than other pumpkin treatments followed by ice cream with 10% pumpkin. Treatment with 40% pumpkin ranked the lowest scores (71out of 100 point) and was described with starchy taste and soggy body. Ice cream from mix with 30% pumpkin had bet creamy colour and flavour with soft body & texture. Finally, it could be concluded that recipe (III) containing 30 % cooked or roasted pumpkin is recommended for manufacturing functional pumpkin ice cream with high quality and considered as a good source of dietary fibers (0.58-0.61%) as compared with 20% pumpkin ice cream (0.34-0.49%).

Table 4. Sensory evaluation of ice cream samples made with different quantities of cooked or roasted pumpkin

Characteristics	Control	Treatments (Pumpkin quantities)							
		Cooked pumpkin				Roasted pumpkin			
		I	II	III	IV	I	II	III	IV
Flavour (45)	45	30	40	41	40	35	43	43	40
Body& texture (30)	30	28	25	24	15	28	23	22	15
Melting properties(15)	13	12	11	12	8	12	11	12	8
Colour (10)	9	7	9	9	8	7	9	9	8
Total score (100)	97	77	85	86	71	82	86	86	71

REFERENCES

Arbuckle, W.S. (1986). *Ice Cream, 4th Ed. pp.326-362.* AVI Publishing Company, Inc., Westport, Connecticut, USA.

Cummings, J.H. and H.N. Englyst (1991). What is dietary fiber? *Trends in Food Sci. & Technol. 2: 99-103.*

Das, T.C.; M.R. Rao; N. Krishnaia and K. Suphakar (1989). Ice cream made by incorporation of different level of potato pulp. *Indian J. Dairy Sci, 42: 295 -302.*

Deeth, H.C. and A.Y. Tamime (1981). Yoghurt: Nutritive and therapeutic aspects. *J. Food Protect. 44: 78-86.*

Hammad, Y.A.; L.F. Hamzawi; A.N. Zedan and A.E. Khader (1985). The use of defatted soy flour in ice cream manufacture. *Minufiya J. Agric. Research. 10: 833-840.*

Hamzawi, L.F. and K.M. Kamaly (1992). The quality of stirred yoghurt enriched with wheat grains. *Cult. Dairy Prod. J. 27: 26-29.*

Hughes, M.K. (1995). Diet and coronary heart disease. *Ann. Acad. Medicine, Singapore, 24: 224–232.*

Kaufman, S.P.; J.F. Langler and V.W. Padhye (1990). Yogurt with crisp cereal pieces. *USA Patent 4952414.*

Marshall, R.T.; G.H. Douglas and R.W. Richard (2003). *Ice Cream 6th Ed. pp. 44-49 & 139-142.* Kluwer Academic/Plenum Publishers, New York, USA.

Metwally, A.I. (1994). The use of red sweet potato in ice cream manufacture. *Egyptian J. Dairy Sci., 22: 59-66.*

Olson, J.A. (1986). Some thoughts on the relationship between vitamin A and Cancer. *Adv. Expt. Med. & Biol. 206: 379-398.*

Prakongpan, T.A.; A. Nitithamyong and P. Luangpituksa (2002). Extraction and application of dietary fiber and cellulose from pineapple cores. *J. Food Sci. 67: 1308-1313.*

Reid, W.H. and W.E. Painter (1933). The freezing properties stability and physical qualities of chocolate ice cream, *Missouri, Agric. Exp. Sta., MI University of Mo. Bull. No.185.*

Richardson, H.G. (1986). *Standard Methods for the Examination of Dairy Products 15th Ed.* American Public Health Association Washington. D.C.

Saleem, R.N.; K.A. Shaker and S.M. El-Waeely (1989). The use of soymilk in ice cream mixes. *Egyptian J. Dairy Sci., 17: 281-288.*

Sommer, H.H. (1951). *The Theory and Practice of Ice Cream Making, 6th. Ed. p. 286.* Published by the Author, Madison, Wisconsin, USA.

Vani, B. and J.F. Zayas (1995). Wheat germ protein flour solubility and water retention. *J. Food. Sci. 60: 845-848.*

Vratania, D. L. and M.E. Zabik (1978). Dietary fiber sources for baked products: bran in sugar-snap cookies. *J. Food Sci. 43: 1590 –1594.*

Winton, A.L. (1958). *Analysis of Foods, 3rd Ed. p. 6.* John. Wiley and Sons. Inc., New York, USA.

مجلة حوليات العلوم الزراعية، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م(٥٠)، ع (١)، ١٦١-١٦٨، ٢٠٠٥

صناعة أيس كريم صحى باستخدام ثمار القرع العسلى

[١٢]

زكريا محمد رزق حسن[١]

١- قسم علوم الاغذية - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - القاهرة - مصر

تهدف الدراسة إلى انتاج مثلوجات قشديه ذات خواص وظيفيـة وصـحيه لارتفـاع محتواها من الالياف الخام الغذائية. حيث تم إضافة معجون القرع العسلي سواء المسلوق أو المشوى كمصدر للألياف الى مخلوط المثلجات القشديه بنسب ١٠%، ٢٠%، ٣٠% و ٤٠ %. ودراسة تأثير ذلك على خواص كل من المخلوط والمثلوجات القشدية الناتجة.

وقد أظهرت النتائج أن إضافة القرع العسلي أدى الى زيادة فى الحموضة وإنخفاض نقطة التجمد ونقص فى الثبات البروتينى للمخلوط. كما أظهرت النتائج أن زيادة نسبة معجون القرع العسلي فى مخاليط المثلجات يؤدى الى زيادة كل من الوزن النوعى ووزن الجالون وكذلك اللزوجة. كما أظهرت النتائج إنخفاض نسبة الريع للمثلجات القشدية الناتجة وزياده مقاومتها للانصهار بزيادة محتواها من القرع العسلى. وأوضحت نتائج التحكيم الحسى أن المثلوجات الناتجة من المخاليط المحتوية على ٣٠% ، ٢٠% معجون القرع العسلى قد حصلت على أعلى درجات التقييم الحسى. لذلك توصى الدراسة أنه يمكن إستخدام القرع العسلى بنسبة ٣٠% للحصول على منتج لبنى غنى بالالياف الغذائية مما ينعكس بدوره على القيمة الغذائية والصحية للمنتج.

تحكيم: ا.د جمال الدين أحمد مهران

ا.د نبيل محمد يوسف مهنا