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EFFECT OF USING ARTICHOKE AS A SOURCE OF INULIN ON LOW CALORIE ICE CREAM QUALITY

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ABSTRACT

The effect of artichoke as a source of inulin which is used as a fat replacer on physic-chemical characteristics and sensory attributes of ice cream with different level of fat (12, 9, and 6%) with 11% SNF were investigated. Artichoke blend was used in different combinations for substitution with fresh skim milk (9 % T.S) in the preparation of ice cream with 12, 9 and 6 % fat comparing with control (15% fat).The results revealed that artichoke ice cream treatments were close to the control by a sensory panel. It was observed that artichoke ice cream had the highest content of ash, fiber and carbohydrate, while it had the lowest content of protein compared with control. The decreases in the total energy were pronounced in artichoke ice cream due to the decrease in fat percentage. Moreover, the inulin percentage increased with increasing the amount of added artichoke blend up to 1.7 %. Artichoke ice cream obtained had the highest potassium, magnesium and iron. Artichoke in ice cream mixes increased the specific gravity, weight per gallon and viscosity. Also, the data showed a marked increase in melting resistance in the artichoke ice cream with 9 % fat. On the other hand the overrun of artichoke ice cream treatments was in range 58 – 68 %. It can be recommended that the addition of artichoke as a source of inulin used as fat replacer and functional ingredient to prepare optimize quality law calorie ice cream.

Keywords: Ice cream, artichoke; inulin; fat replacers, functional ingredient

INTRODUCTION

Functional foods and nutraceuticals provide an opportunity to improve the human health, reduce health care costs and support economic development in rural communities. Consumers are increasingly interested in the health benefits of foods and began to look beyond the basic nutritional benefits of food to the disease prevention and health enhancing compounds contained in many foods (Lattanzio *et al.,* 2009).

Regular ice cream production dropped to 5.2% between 2003 and 2004 in the United States. However, in the low fat and nonfat categories, hard ice cream production increased 4.5% over the same period (Anonymous, 2005). The increase in lower fat ice cream sales could be due the fact that consumers are getting more accustomed to the taste of lower fat products (Stubenitsky *et al.,* 1999) and are appreciating the taste of reduced fat products because of their level of motivation (Ka¨hko¨nen, 2000), or it may be that they are simply making more health conscious purchases. A study by (Li *et al.* 1997) pointed to the latter of the two assumptions. Acceptance scores by US panelists for vanilla ice cream increased progressively for samples

varying in fat level in increments of 2% from 4 to 10%, even by panelists who claimed to prefer a lower fat type of product. Although there is clear interest in lower fat frozen desserts, the results indicate that additional work is needed to improve their quality. In the food technology carbohydrate prebiotics, like inulin, are used to improve body and mouthful, as stabilizers, fat replacers, and flavor enhancers (Voragen, 1998). Moreover, inulin is used as an alternative for fat, sugar and texturizing agent (Tungland and Meyer, 2002).

Inulin is a linear indigestible polysaccharide with ties of fructose with glucose Terminal of β (2→1).Inulin behaves like dietary fibers(Flamm, *et al.*, 2001) and stimulates selective growth of beneficial bifidobacteria (Roberfroid, *et al.*,2010). It causes improvements in absorption of calcium reduction of triglycerides fatty acids in the liver and subsequently reduction triglyceride content of blood serum (Kaur and Gupta, 2002).

Artichoke as a source of inulin can offer new chances to the food industry for novel and healthy future products. Globe artichoke (*Cynara cardunculus* var. *scolymus* (L.) Fiori) is a large immature flower rich in medicinal substances. It is considered one of the most important vegetable crops in the countries bordering the Mediterranean basin including Egypt. It has a low content of fat and high levels of minerals (potassium, sodium, and phosphorus), vitamin C, fibers, polyphenols, flavones, inulin and hydroxycinnamates - caffeoylquinic acid derivatives (Ceccarelli *et al.,* 2010; Pandino *et al*., 2011).

Historically, this plant has been used in folk medicine since Roman times, for its health benefits which are mainly due to the high content of polyphenols and inulin (Lattanzio *et al.*, 2009; Pandino *et al.*, 2011). These substances are very important for the human nutrition since they are involved in the prevention of cancer (Williamson and Manach, 2005; Clifford and Brown, 2006). Among the common edible plants, artichoke is the richest source of dietary antioxidants (Brown and Rice-Evans, 1998), therefore it could be used in phytopharmaceutical applications (Lattanzio *et al.*, 2009; Ceccarelli *et al.*, 2010). The pharmacologic properties of artichoke flower heads are well documented in several in vivo and in vitro studies for the treatment of hepato-biliary dysfunction, dyspeptic syndromes, gastric diseases, as well as for inhibition of cholesterol biosynthesis and low density lipoproteins (LDL) oxidation – agents responsible for arteriosclerosis and coronary heart disease (Lattanzio *et al.,* 2009; Ceccarelli *et al.*, 2010) Therefore, the research aims to use artichoke as a source of inulin to produce low calories ice cream with high functional properties suitable for many private groups, such as patients with liver disease, obesity and high cholesterol.

MATERIALS AND METHODS

Materials:

Fresh cream (45 % fat) and Fresh skimmed milk (9.0 % MSNF) from the Unit of Milk Industry, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt. Skimmed milk powder (96% TS), Can sugar,

and Globe artichoke (*Cynara cardunculus* var. *scolymus* (L.) Fiori) purchased from the local market. Carboxy Methyl Cellulose (CMC) used as stabilizer was obtained from the Pharmaceutical Chemicals Nasr Co., Abo-Zaabel, Kalubia. Vanilla and Cacao powders were purchased from the local market. Cacao contained 3% protein, and 3% lipid. .

Methods:

Preparation of Artichoke blend :

The Nora artichoke was taken. the leaves was removed and the pubescence artichoke. , then the artichoke calyx was washed with tap water to remove the dust followed by distilled water and cooked according to Lutz *et. al.* (2010) and Robert *et. al*., (2012). About 650 ml of distilled water was poured into a boiling container. 450 g of the sample was added to the boiling water and let to boil for 20 min., then the samples were cooled and blended for a smooth homogeneous mixture. The artichoke blend was adjusted to 9% total solid as fresh skimmed milk used by distilled water .The chemical composition was determined as shown in table (2).

Preparation of ice mixtures:

The ice mixtures were manufactured according to Marsall *et al*. (2003). The formula of the ice mixtures is shown in table (1). The composition of basic artichoke ice cream was 11% milk solid nonfat (MSNF), 15 % fat for control and 12, 9& 6 % fat for artichoke ice cream treatments. Artichoke blend replaced fresh skim milk at rate 0, 25, 50, 75 %. All powder materials such as sugar, stabilizer, skim milk powder and cacao were mixed with fresh skim milk for 2 minutes, then the cream (45% fat) and lastly artichoke blend. The mixture was heated to 85 ˚C and cooled to 5 ˚C. It was kept for 24 hrs at 5 ˚C (time for aging). After aging the ice mixtures was taking to the ice maker device (5 ˚C) and adding vanilla, after 10 min. the ice cream transferred to the freezer in sample containers till analyzed .

Methods of Analysis:

The total solids, protein, ash and crude fiber were determined according to AOAC (2007). The carbohydrate content was calculated by deference. pH value was measured by laboratory pH-meter(Jenway 3505 pH meter). Viscosity of ice cream mixes was measured after 24 hrs at 20 º C and at 50 r.p.m. using spindle no. 6 in Brookfild DV-E Viscometer, (Brookfild Engineering Laboratories, Inc, Middle boro, U.S.A.). The specific gravity and weight per gallon were determined according to Arbuckle (1986) the specific gravity was multiplied by the factor 3.7858 to give the weight per gallon in kilograms. Overrun was calculated according to Marsall *et al.* (2003). Freezing point was determined using specific thermometer. Melting resistance of the frozen ice was determined according to Arbuckle (1986). Samples of ice cream were placed in controlled cabined at 20 º C and the melted portions were weighted every 15 min for 2 hrs.

Table (1) Formula of Artichoke ice cream mixes

Ingredients	Treatments			
	Control	T_1	T_2	T_3
Fresh cream (45% fat)	333	266	200	133.3
Fresh skimmed milk (9.0 % T.S)	435.8	380.3	288.5	162
Artichoke blend (9.0 % T.S)	-	126.7	288.5	485.9
Skimmed milk powder (96.0 % T.S)	61.2	57	53	48.8
Sucrose	160	160	160	160
Cacao	5	5	5	5
Carboxy Methyl Cellulose (CMC)	5	5	5	5
Vanilla	0.5	0.5	0.5	0.5
Weight of mix (g)	1000.5	1000.5	1000.5	1000.5

Control: Ice cream (15 % fat) without Artichoke.
T_1 : Ice cream (12% fat) with 25 % Artichoke replaced fresh skim milk.
T_2 : Ice cream (9% fat) with 50% Artichoke replaced fresh skim milk.
T_3 : Ice cream (6% fat) with 75 % Artichoke replaced fresh skim milk.

Determination of minerals: Minerals content of ice cream mixes including (Ca, P, Mg, Fe, Zn) were determined by colorimetric methods according to El-Merzabani *et al*., (1977) for Phosphorus, Teitz (1983) for Magnesium, Ginder and King (1972) for Calcium, Dreux (1977) for Iron and Hayakawa and Jap (1961) for Zinc.

Determination of Inulin: inulin was determined by HPLC method according to Wang *et al*., (2010).

Calorie value according to equation of FAO / WHO, (1985)

Calorie value = 4 (protein % + carbohydrate %) + 9(fat %)

Sensory evaluation:

The Sensory evaluations was assessed by the staff of the Dairy Department, Animal Production Research Institute using the following scale:

50 for flavor, 40 for body and texture, and 10 for melting quality points. The total scores were 100.

RESULTS AND DISCUSSION

Chemical composition of Artichoke blend

Table (2) showed chemical composition of artichoke blend. Data indicated that artichoke cooked had a low fat and protein content and high level of carbohydrate these finding were close to the results of El Sohaimy (2013). Carbohydrate includes 77.1 % fibers which contained 66.67 % inulin , these results trended to that of Abou-Arab *et al*. (2011). Inulin as prebiotic plays an important role in human nutrition due to it is reduced the risks of cancer, arteriosclerosis and coronary heart disease (Clifford and Brown, 2006; Lattanzio *et al.,* 2009)

Table (2) Chemical composition of Artichoke blend

T.S %	**9.00**
Fat %	0.11
Protein %	0.96
Ash %	1.12
Total carbohydrate %	6.81
Fiber %	5.25
Inulin %	3.50

Chemical composition of Artichoke ice cream mixes:

Table (3) showed the chemical composition of Artichoke ice cream. It was noticed that the Artichoke ice cream contained more ash, total carbohydrate and fiber. That increase was proportional to the level of the artichoke. While, protein content was lower than the control. The addition of artichoke increased fiber content of ice cream by 0.67 to 2.55 % depending on the added ratio of artichoke, due to the high level of fiber in artichoke (table 3). The inulin in the ice cream containing artichoke ranged from 0.44 % - 1.70 % depended on the level of artichoke added. These ratio can be contribute in range 33.85 – 130.77 % and from 12.57 to 48.57 % to average daily intake for young children and for teenage and adults meals respectively according to Moshfegh *et al.,* (1999) who indicated that the mean intake of inulin varies by gender and age groups, at a range from 1.3 g/ day for young children to 3.5 g / day for teenage boys and adult males.

The decrease in the total energy was pronounced in ice cream containing artichoke blend due to the decrease in fat percentage. Pervious study by Anonim (2003) reported that using inulin as alternative fat and sugar reduced the calorie in ice cream.

Table (3) Chemical composition of Artichoke ice cream mixes

Items	**Treatments**			
	Control	**T1**	**T2**	**T3**
T.S %	38.95	35.96	33.00	30.10
Fat %	15	12	9	6
Protein %	3.65	3.43	3.20	2.94
Ash %	1.04	1.12	1.26	1.35
Total carbohydrate %	19.26	19.41	19.54	19.81
Fiber %	0.25	0.92	1.77	2.80
Inulin %	-	0.44	1.01	1.70
Calorie value (Kcal/100g)	226.64	199.36	171.96	145.00

Table (4) showed that the potassium, magnesium and iron contents of ice cream containing Artichoke increased with increasing artichoke addition as artichoke contained high level of these minerals as reported by Ceccarelli *et al., (2010*) While the values of calcium and phosphorus decreased, this may be attributed to calcium and phosphorus in artichoke blend which were lower than skim milk . Also the data revealed that the addition of artichoke in ice cream had non considerable variation on zinc content.

Table (4) Minerals contents (mg/100 g) of Artichoke ice cream mixes

Minerals	Treatments			
	Control	T_1	T_2	T_3
Ca	145	133	119	101
P	115	110	104	96
K	177	185	196	210
Mg	14	15	16	18
Zn	0.50	0.49	0.47	0.45
Fe	0.07	0.13	0.21	0.32

Physical properties of Artichoke ice cream mixes:

The data in table (5) showed slight difference in the pH values of the ice creams, ranging from 6.05 to 6.09.The results indicated that addition of artichoke blend increased the viscosity of ice cream mixes compared to control. That attributed to the high content of fiber including inulin in artichoke as shown in table (2). Inulin has ability to link the water molecules and forming a gel –like network (Franck, 2002). Also, the specific gravity of ice cream mixes increased with artichoke added to ice cream and consequently increased its Wight per gallon. Also, the high freezing point of artichoke ice cream was observed.

Table (5) Physical properties of Artichoke ice cream mixes.

Items %	Treatments			
	Control	T1	T2	T3
pH values	6.09	6.08	6.07	6.05
Viscosity (C.P)	7150	8040	8840	9620
Specific gravity (gm/cm^3)	1.047	1.084	1. 088	1. 091
Weight per gallon (Kg)	3.964	4.104	4.119	4.130
Freezing point (^{o}C)	- 2.70	- 2.45	- 2.38	- 2.27

Properties of Artichokes ice cream:

The overrun values are shown in Table (6). Artichoke ice cream samples had overrun values ranged from 68% – 58% and 72% control. This value of overrun Artichoke ice cream with different levels of fat (6-12%) can be considered as remarked for good quality of ice cream according to Kirchhubel and Rodth (1978) who reported that an overrun 60% was necessary for good quality ice cream.

Changes in the melted proportions of ice cream samples during meltdown tests were shown in Table (6). The melted proportion of ice cream varied with fat and artichoke content. The higher fat content retarded melting. The melting resistance of Artichoke ice cream treatments increased except T_1 (12 % fat). Since structure formation in ice cream is extremely complex (Goff 1997).That might be related to the interaction of milk fat with artichoke blend.

Table (6) Physical properties of Artichoke ice cream.

Items	Treatments			
	Control	T_1	T_2	T_3
Specific gravity (gm/cm^3)	0.840	0.920	0.951	0.978
Weight / gallon (kg)	3.180	3.483	3.600	3.703
Overrun %	72	68	65	58
Melting resistance as loss %after: 15 min.	-	-	-	-
30 min.	-	3.28	-	-
45 min.	3.58	14.37	2.54	2.18
60 min.	7.98	26.10	5.14	2.45
75 min.	21.10	33.73	11.42	14.18
90 min.	31.67	43.48	28.49	23.34
105 min.	42.39	50.51	38.56	45.31
120 min.	50.79	55.91	46.78	50.46

Sensory evaluation of Artichoke ice cream:

Flavor, body and texture, and melting quality characteristics of the ice cream samples were tested by panelists (Table 7). The full fat ice cream gained the highest scores for acceptability. Artichoke ice cream samples had relative lower scores than the control, while T_1 Artichoke ice cream had higher scores in flavor. There were no high differences between artichoke ice cream samples and the control in their body and texture scores. Previously Zimeri and Kolini (2002) showed the thermal properties and fat mimetic properties of inulin could be as a result of its low partial crystallization main usage of this material as texturizing agent, especially in low fat products like yogurt, ice cream and margarine, is to achieve an specific amount of fat content (Devereux *et al.,* 2003). Generally the artichoke ice cream had similar scores to the control, it could be suggested that artichoke as inulin source which can use as fat replacer in ice creams preparation.

Table (7) Sensory evaluation of Artichoke ice cream

Treatments	Flavor (50)	Body & texture (35)	Melting Quality (15)	Total (100)
Control	46.8	32.3	14.2	93.3
T_1	47.2	32.0	13.0	92.2
T_2	45.3	31.8	13.7	90.8
T_3	44.2	31.0	13.2	88.4

CONCLUSIONS

The study showed that Artichoke addition improved the functional characteristics of ice cream. Comparing the control with Artichoke ice cream samples, it was observed that the trend was not uniform for the change in the melting rates of ice cream. Artichoke blend imparted viscous character to the ice cream samples. The Artichoke ice cream treatments with fat levels 12, 9 and 6 % gained similar sensory scores as the full fat sample (15 %). These

results showed that Artichoke blend could be used as fat replacer due to its inulin content and also as a functional ingredient to obtain low calorie ice cream.

REFERENCES

Abou-Arab, A.A.; Talaat,A.H. and Abu –Salem,M.F.(2011)). Physico - chemical properties of inulin produced from Jerusalem artichoke tubers on Bench and Pilot Plant Scale. Australian J. of basic and applied sciences 5 (5): 1297-1309.

Anonim, (2003). Energy reduce ice cream. Dalya Dıs Tic. Paz. A.S. Tanıtım Bulteni, İstanbul, 12 -14.

Anonymous (2005). Dairy Facts, ed. Dairy Food Assoc., Washington,DC.

AOAC (2007). Association of Official Analytical Chemists. Official Methods of Analysis 18th Ed. ,Washington, D.C ,USA.

Arbuckle, W.S. (1986). Ice Cream. 4th ed*, The AVI* Publishing Company, Inc , Westport, Connecticut, U.S.A .

Brown, J. E., and Rice-Evans, C.A. (1998). Luteolin-rich artichoke extracts protects low density lipoproteins from oxidation in vitro. Free Radical Res., 29, 247-255.

Ceccarelli, N.; Curadi, M.; Picciarelli, P.; Martelloni, L.; Sbrana, C. and Giovannetti, M. (2010). Globe artichoke as functional food. Mediterr. J. Nutr. Metab., 3, 197-201.

Clifford, M. and Brown, J. E. (2006). Dietary flavonoids and health, broadening the perspective. In O. Andersen, & K. Markham (Eds.), Flavonoids: Chemistry, biochemistry and applications. CRC Press, Boca Raton, USA.

Devereux, H.M.; Jones, G.P.; Mc.Cormac, L.and Hunter, W.C. (2003), Consumer Acceptability of Low Fat Foods Containing Inulin and Oligofructose, journal of food science vol. 68,Nr 5, 1850.

Dreux, C. (1977). Selected method, Analysis of human serum assay of iron II. Method using bathophenanthroline. Se-Iron II (bathophenanthroline). Ann. Biol. Clin. 35: 275.

El- Sohaimy, S. A. 1. (2013). The effect of cooking on the chemical composition of Artichoke (*Cynara scolymus L.).* African Journal of Food Science and Technology (ISSN: 2141-5455)Vol. 4(8) pp.182-187.

El-Merzabani, M.M.; El-Aaser, A.A. and Zakhary, N.I. (1977). A New method for determination of inorganic phosphorus in serum deproteinization. J. Clin. Chem. Clin. Biochem. 15: 715 - 718.

FAO / WHO (1985). Energy and protein requirement. Geneva Report of a joint FAO/WHO /UNU Expert Consultation. WHO. Techical report series No.724.

Flamm, G.; Glinsmann, W.; Kritchevsky, D.; Prosky, L. and Roberfroid, M. (2001). Inulin and oligofructose as dietary fibre: a review of the evidence. Critical Reviews in Food Science and Nutrition 41(5):353- 62.

Franck, A. (2002). Technological functionality of inulin and oligofructose. British journal of Nutrition 87(2): S287-S291.

Ginder, M. and King, I.D. (1972). Chemical method for determination of calcium in serum. Am. J. Clin. Path. 58: 376.

Goff, H. D. (1997). Colloidal aspects of ice cream – Review. Int. Dairy J. 7, 363 – 373.

Hayakawa, R. and Jap, J. (1961). Chemical method for determination of zinc in serum. JapJ. Toxic Environ. Health 8, 14- 18.

Kähkönen, P. (2000). Consumer acceptance of reduced-fat foods – the effects of product information. EKT series 1195. University of Helsinki, Department of Food Technology.

Kaur, N. and Gupta, A. K. (2002). Applications of inulin and oligofructose in health and nutrition; J. Biosci. 27 , 703 – 714.

Kirchhubel, W. and Rodth, H. (1978).Relationship between overrun and sensory evaluation of ice cream. Backer and Konditor, 26 : 259.

Lattanzio, V.; Paul, A.K.; Vito, L. and Angela, C.(2009). Globe artichoke: a functional food and source of nutraceutical ingredients. J Funct Foods; 1: 131-44.

Li, Z. ; Marshall, R. Heymann, H. and Fernando, L. (1997). Effect of milk fat content on flavor of vanilla ice cream. J. Dairy Sci. 80:3133 – 3141.

Lutz, M.; Henrı´quez and Escobar, M. (2011). Chemical composition and antioxidant properties of mature and baby artichokes (Cynara scolymus L.), raw and cooked. J. Food Comp. Anal. 24:49-54.

Marshall, R. T.; Goff, H. D. and Hartel, R. W.(2003). Ice Cream. 6th ed Kluywer Academic/plenum publishers, New York.

Moshfegh, A.J.; Friday, J.E.; Goldman, J.P. and Chug, J.K.(1999). Presence of inulin and oligofructose in the diets of Americans. Journal of Nutrition 129 (75): 1407S-1411S.

Pandino, G.; Lombardo, S.; Mauromicale, G. and Williamson, G. (2011). Phenolic acids and flavonoids in leaf and floral stem of cultivated and wild Cynaracardunculus L. genotypes. Food Chem., 126, 417-422.

Roberfroid, M.; Gibson, G. R.; Hoyles, L.; McCartney, A. L.; Rastall, R.; Rowland, I.; Wolvers, D.; Watzl, B.; Szajewska, H.; Stahl, B.; Guarner, F.; Respondek, F.; Whelan, K.; Coxam, V.; Davicco, M.; Leotoing, L.; Wittrant, Y.; Delzenne, N. M.; Cani, P. D.; Neyrinck, A. M. and Meheust, A. (2010). Prebiotic effects : metabolic and health benefits. British Journal of Nutrition, 104(Suppl. 2), 51-63.

Stubenitsky, K.; Aaron, J.I.; Catt, S.L. and Mela, D. J. (1999). Effect of information and extended use on the acceptance of reduced- fat products. Food Qual. Pref. 10:367-376.

Teitz, N. W. (1983). Clinical Guide to Laboratory Tests, first Ed., WB Saunders Company, Philadelphia.

Tungland, B.C. and Meyer, D. (2002). Nondigestible Oligo- and Polysaccharides (Dietary Fiber): Their Physiology and Role in Human Health and Food. Comprehensive reviews in food science and food safety.vol. 3, 90-109.

Voragen, A.G. (1998). Technological aspects of functional food-related carbohydrates. Trends Food Sci. Technol., 9, 328 – 335.

Wang, H. Z.; Liang, L.; Wen, S.; Lui, C. and Xu, X. (2010). A comparative study of high performance liquid chromatography and colorimetric method for inulin determination. European Food Research and Technology, 230, 701 – 706.

Williamson, G. and Manach, C. (2005). Bioavailability and bioefficacy of polyphenols in humans. II. Review of 93 intervention studies. Am. J. Clin. Nutr., 81, 243S-255S.

Zimeri, J.E. and Kokini, J.L.(2002). The effect of moisture content on the crystalline and glass transition temperature of inulin. Carbohydrate Polymers. 48:299–304.

تـأثير إسـتخدام الخرشـوف كمصـدر للإنـولين علـى جـودة الأيـس كـريم مـنخفض السعرات الحرارية

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يعتبر الخرشوف مصدر غنى للإنولين ويستخدم كبديل للدهن ولذلك تم إستخدامه فى هذه البحث لدراسة تأثيره على الخصائص الفيزوكيميائية والحسية للأيس كريم مع نسب مختلفة من الدهن (١٢ ، ٩، ٦٪) وجوامد لادهنية للبن ١١٪ SNF. وقد أستخدم الخرشوف في إعداد هذه المخاليط بإستبداله محل اللبن الفرز الطازج (٩ % جوامد كلية) ومقارنتها بمعاملة الكنترول (١٥% دهن). وقد أظهرت النتائج تقارب معاملات أيس كريم الخرشوف مع معاملة المقارنة فى الخحواص الحسية. ولوحظ أن المعاملات كانت أعلى فى محتواها من الرماد والألياف والكربوهيدرات، في حين كانت المعاملات أقل فى المحتوى من البروتين مقارنة بالكنترول. كما كان واضحا إنخفاض المعاملات فى إجمالى الطاقة وذلك نظرا لإنخفاض نسبة الدهن. وقد تبين من النتائج أن إضافة الخرشوف لمعاملات الأيس كريم أدى إلى إحتوائها على نسبة من الإنولين وصلت إلى ١.٧٪ وكذلك أعطى أعلى نسب من البوتاسيوم والمغنيسيوم والحديد. بالاضافة إلى زيادة الوزن النوعي، والوزن /جالون واللزوجة بزيادة نسبة الخرشوف في خليط الأيس كريم. كما أظهرت النتائج زيادة مقاومة إنصهار أيس كريم الخرشوف فى المعاملة ٩٪ دهن (T_2) مقارنة بالكنترول. من ناحية أخرى كان ريع أيس كريم الخرشوف فى نطاق ٥٨-٦٨٪ التى تدل على جودة المنتج .

وبناء على هذة الدراسة يمكن التوصية بإضافة الخرشوف كمصدر للإنولين المستخدم كبديل للدهن بالإضافة إلى خصائص الخرشوف الوظيفية لإنتاج أيس كريم منخفض السعرات الحرارية وعالى الجودة.