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Effect of *Salvia macrosiphon*seed gum as a fat replacer on physico-chemical and sensory characteristics of lowfat ice cream

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ABSTRACT

Elimination or reduction the amount of dietary fat in ice cream is of special importance. Application of either protein or carbohydrate based fat replacers can improve the properties of these products. The aim of this research was to develop a functional low fat Ice cream by the use of modified *Salvia macrosiphon*seed gum as a fat mimetic. For this purpose, *Salvia* seed gum as a native fat replacer and stabilizer was used at three levels: 0.05%, 0.1%, 0.2% w/w. Also conventional stabilizer(*Salep*) was used as control treatment. After treatments, physicochemical tests including melting resistance, pH, overrun, specific gravity and sensory tests including measurement of flavor, intensity of coldness, viscosity, degree of smoothness, liquefying rate and total acceptance were analyzed. Results showed no significant differences between physicochemical and sensory properties of the samples (p<0.0.5).

KEYWORDS

Low fat ice cream;
Salvia macrosiphon seed gum;
Salep;
Fat replacer.

INTRODUCTION

Ice cream isconstituted of acomplexmultiphase system consisting of icecrystalsaircells and fat globules embedded in a high viscous freeze concentrated matrix phase[12, 4]. Also, ice cream is characterized by countless interfaces between its different constituents. Milk fat has been recognized as a critical parameter for the formation and support of structural characteristics of ice cream as well as for the perceived textural quality e.g. lubrication of tongue,richnessof mouth-feel, enhancement of creaminess, thickness and flavor perception[24]. Typically, icecream contains 10-16% fat but recently some ice creammanufactures have attempted to lower the level of fat fraction due to health concerns and have replaced the fat with either carbohydrates or proteins[11, 14]. High intake of fat is considered a risk factor in nutrition related diseases, such as obesity, cardiovascular diseases, such as types of cancer. Therefore, nutritionists recommend that dietary fats should contribute less than 30% of total energy intake. Ice cream is very popular food, but consumers prefer to avoid its consumption due to the high fat content of ice cream[1, 18].

The structure of ice cream has been identified as three-component foam, made up of a network of fat globules and ice crystals dispersed in a high-viscosity aqueous phase. The challenge in workingwith low-fat ice creams is related to the fact that the fat globule network would either be disrupted or be absent, and this could seriously impact the texture of the product[25].

Milk fat is the main contributor to the rich flavor and mouth feel associated of ice cream[20]. Reduction the fat content of ice cream led to high melting rate, more icy and watery body, inferior texture with fewer visible air bubbles and lower richness in taste as compared to full fat ice cream[4]. Several strategies have been suggested to overcomethese defects such as using emulsifiers[6], using fat replacers[3], using practically hydrolysescasein micelles[8], using of high pressure homogenization [13] and using whey protein concentrate treated by hydrostatic pressure[19, 9]. The genus Salvia (*Labiatae*) contains more than 700 species, which about 200 out of them exist in Iran and is probably found in neighboring countries. Wild sage seed (*Salvia macrosiphon*) is a small, rounded seed, which readily swells in water to give mucilage[21, 7].

The aim of this research was to develop low fat ice cream using*Salviamacrosiphon*seed gum as a fat mimetic.

MATERIALS ANDMETHODS

Materials

Pasteurized milk (1% fat) was purchased fromKanyar Industry Co (Quchan), Iran. Homogenized and pasteurized cream (30% fat) purchased fromPegah dairy Industry Co Mashhad, Iran. Sugar, Vanilla, *Salep*and *Salvia* seed were obtained from a local confectionery market,GonbadKavus, Iran. *Salvia macrosiphon*seed gum was prepared on the basis of Bostan et al, 2010[7].

Ice cream formulation and processing

Ice cream mix was formulated to contain3% cream, 15% sugar, 12% milk solid nonfat (MSNF), 0.05-0.2 % stabilizers and 0.1% vanilla. Formula forall the mixes summarized in TABLE 1. Liquid ingredients including milk and cream were mixed together and warmed up to 50ºC. Dry ingredients were mixed thoroughly and then added to the liquid ingredients using a mixer (Model B.G.300P; Parskhazar, Iran). The mixes were pasteurized at 80ºC for 25seconds, cooled immediately to 5ºC and aged at 4-5ºC for24 hours. After aging, vanilla extract was added and the freezing was carried out in a batch ice cream marker (Feller ice cream marker,Model IC 100, Feller, China) for about 30 minutes. Samples were packed in 50mL plastic cups and placed in a freezer at -12ºC(Electrosteel, Model ES.453,Mashhad, Iran) for hardening.

Physicochemical analysis

pH

pH was tested with a pH meter at5ºC (Model,Gp353, UK). Each sample was mixedthoroughly and the pH was noted[2].

Meltingresistance

A 30g sample of ice cream poured in a Buchner funnel on the top of a flask and allowed to melt at room temperature (24±1ºC) for 15min. Then the dipped volume was weighed and melting resistance was obtained using the following equation:

Equation 1

$$Meltingresistance = \frac{A1-A2}{A1} \times 100$$

WhereA_1 and$A_2$are the weight of initial and melted samples respectively[20].

TABLE 1 : Formulation of ice cream mixes containing different levels of gum

Ingredient	Mix 1	Mix 2	Mix3	Mix 4	Mix 5	Mix 6
Cream	5.025%	5.025%	5.021%	5.021%	5.014%	5.014%
Salvia macrosiphon	0.05%	-	0.1%	-	0.2%	-
Salep	-	0.05%	-	0.1%	-	0.2%
Vanilla	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Suger	15%	15%	15%	15%	15%	15%
MSNF	12%	12%	12%	12%	12%	12%
Milk	67.825%	67.825%	67.779%	67.779%	67.686%	67.686%

Specific gravity

In order to measure the specific gravity, apicnometer(Empty, filled with distilled water at 25ºC and filled with ice cream mixture) was weighted. Bulk density was calculated from the following equation:

Equation 2

$$SG = \frac{G3-G2}{G2-G1}$$

Where $G_1$is the weight of the emptypicnometer, G_2 weight of the picnometer with distilled water and G_3 weight of picnometerwith ice cream mixture[20].

Overrun

According to equation 3 overrun was calculated by comparing the weight of a known volume of ice cream (M_2) to the weight of the same volume of unfrozen ice cream mix (M_1)[20].

Equation 3

$$\%Overrun = \frac{M1-M2}{M2} \times 100$$

Sensory evaluation

The ice creams were evaluated for sensory characteristics (viscosity, coldness, firmness, degree of smoothness, liquefying rate and total acceptance. All the samples were served in 50 ml plastic containers

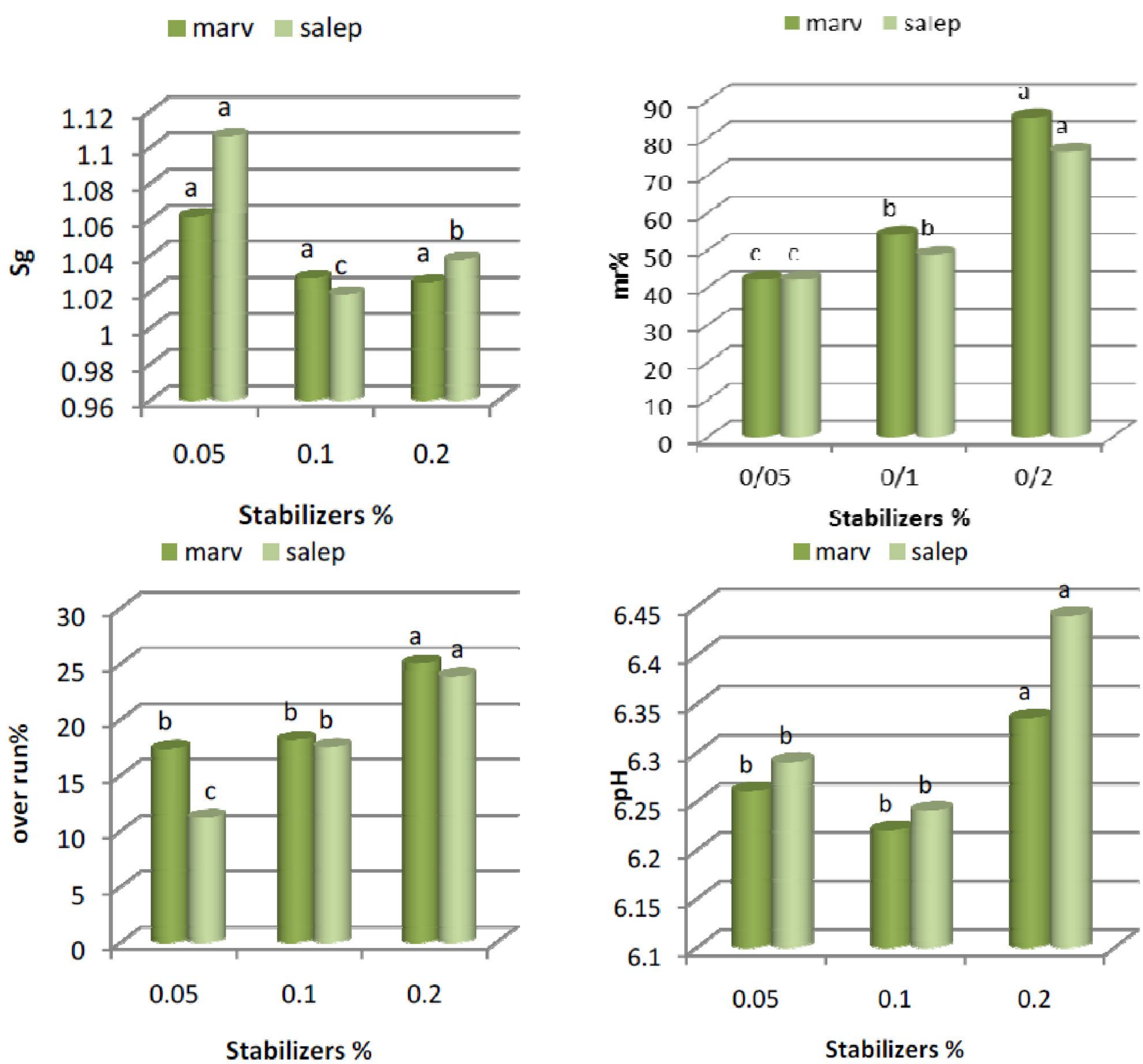

Figure 1 : Effect of type and concentration of the Salvia gum and Salep on the physicochemical properties of low-fat ice cream

with lids and the evaluation was done at 24±1ºC under white lights. Panelists were selected from the student population. In order to test panelists from the first training session, three coded samples were given which two of them were alike. Finally, 8 panelists, six females and two males, all between the ages of 26 and 40 were selected. One 30 min training sessions was held. In these sessions, definition of attributes and assessment techniques were introduced and the sample evaluation was done practically. Sensory evaluations of appearance, flavor, body and texture, and total acceptance were performed using the 9-point scale (1=poor, 5=average, 9= excellent). Other attributes were assessed using 9-point scale too, according their definitions. The ballot is shown in Figure 1[4]. Four panel sessions were established and foursamples were assessed in each one. The samples were tempered in a batch freezer for 10 days after production and presented at the same time in a random order. In this study, sensory analyses were performed in 2 replications.

Statistical analysis

The experimental design was a completely randomized, performed intwice on separate days. Data was subjected to ANOVA analysis using SAS(version 9/1) statistical analysis systemprogram. Means were separated using Duncan' s Multiple Range Test and results were considered significant for*p*<0.05. Curves fittingwas done by Microsoft Excel (2010).

RESULTS AND DISCUSSION

Physicochemical properties

The data are given in TABLE 2 which shows that the physicochemical properties for almost all the treatments are significantly different (*p*<0.01).

Melting resistance

The mean values of melting resistance (MR) are presented in Figure 1 which shows significant differences between the treatments (*p*<0.01), ranging from 42.5-85.45%. In all cases, melting resistance increased as gum concentration increased.

In a study done by Kunna and Abdel Razig(2013) the effect of some additives on the rheological and sensory properties of low fat ice cream during storage were investigated. Results showed that pectin induced the lowest melting rate (7.3%) followed by WP (9.0%), lecithin (10.0%) and control sample (11.3%). Francy*et al*(2012) found that the melting rate and structure of ice cream were not affected markedly by differences in the protein content. Soukoulis*et al* (2010) found that increased viscosity and foamy appearance, increased resistance to melting the ice cream. The contribution of fat to the structural characteristics of ice cream as well as its reduced heat conductivity can explain the former effects[22].

pH

According to Figure 1, the pH values show difference between samples containing *Salvia* seed gum and *Salep* (*p*< 0.01). Khalil and Embaby(2012) produced low fat ice cream with powdered*Jambul* fruit which exhibited significantly lower pH value than the full fat ice cream.

Overrun

The overrun of low fat ice cream samples was significantly affected by using additive[18]. The results of the comparison test for overrun is shown in Figure 1 which shows significant difference (*p*<0.01). According to the results, increasing the amount of stabilizer increased the overrun. Overrun was at the highest rate for sample containing 0.2%*Salvia* seed gum. Kirchhubeland Rot (1978), reported that an overrun of 60% was necessary for good quality of ice cream, and different overrun values might be obtained according to the type of emulsifier used. Kunna and Abdel Razig(2013), reported thehighest overrun of low fat ice cream containing pectinat 49%, followed by the formulation containing whey protein (48%), lecithin (40%) and control sample (38%). According to a study conducted by Khalil andBlassy(2011), adding date pulp enhanced the overrun in low fat ice cream.

Specific gravity

Ice cream specific gravity varies depending on the constituents between 1.0544and 1.1232[20]. Our finding in Figure 1 indicate that the difference is not significant (*p*>0.05), except for the samples containing *Salep* (*p*<0.01). Khalil and Blassy (2011), reported that the Incorporation of air into ice cream mix during the pre-

TABLE 2 : The results of physicochemical tests of samples of low- fat ice cream

Formulation		pH	Overrun	Specific gravity	Melting resistance
	0.05%	6.2600*	17.3500**	1.06145ns	42.0500**
Salviamacrosiphon	0.1%	6.2200*	18.1500**	1.02740ns	54.00**
	0.2%	6.33500*	25.0250**	1.13805ns	85.4500**
	0.05%	6.2900**	11.1500**	1.105900**	42.0500**
Salep	0.1%	6.2400**	17.500**	1.018300**	48.700**
	0.2%	6.4400**	23.8500**	1.037550**	76.35**

***: *p*<0.05 (95%), **: *p*<0.01 (99%), ns: *p*>0.05 (95%).**

TABLE 3 : The results of sensory tests of low-fat ice cream

Formulation		Intensity of coldness	Viscosity	Flavor	Degree of smoothness	Liquefying rate	Total acceptance
	0.05%	8.3500**	6.1500**	5.7500**	6.1500**	6.8500**	5.6500**
Salvia macrosiphon	0.1%	6.7000**	5.9500**	5.7500**	6.8500**	6.2500**	6.9000**
	0.2%	5.4500**	7.9000**	4.8500**	7.6500**	6.0500**	8.0000**
	0.05%	7.5500*	5.5500*	4.2000**	5.6500**	6.4500*	4.5000*
Salep	0.1%	7.150*	5.3000*	5.7500**	7.1500**	6.1500*	5.2000*
	0.2%	6.800*	6.7500*	5.0500**	7.4000**	5.4500*	6.1000*

***: *p*<0.05 (95%), **: *p*<0.01 (99%), ns: *p*>0.05 (95%).**

freezing process causes a decrease in ice cream specific gravity and consequently to its weight per gallon. It was noticed that the specific gravity of ice cream, weight per gallon of T_1 were lower than T_2. This may be due the higher overrun of full fat Ice cream than control (low fat one without modified date pulp). Ashish*et al* (2010) reportedthat the inclusion of sago in low fat mango ice cream did not adversely affect the overrun in ice cream.

Sensory properties

The data are given in TABLE 3 which shows that the sensory properties for almost all the treatments are significantly different.

Flavor

Milk fat has been recognized as a critical parameter for the formation and support of structural characteristics of ice cream[24]. According to the results shown in Figure 2, the lowest score was obtained for the sample containing *Salep*at 0.05% and overall, marve improved the flavor.

Degree of smoothness

Reducing fat in ice cream and frozen tissue, causes more water and air bubbles in ice cream[23]. The difference between different concentrations of stabilizers was statistically significant (*p*<0.05). The Degree of smoothness increasedby increasing stabilizer content and was at the high rate at 0.2% concentration. The highest (7.65) and lowest (5.65) points, was respectively gained for thesamples containing *Salvia* seed gum and *Salep*.

Intensity of coldness

According to Figure2, increasing the stabilizer concentration decrease the intensity of coldness. The highest score was obtained for the sample containing Salvia seed gum at 0.05%.

Viscosity

The results showed that the samples containing *Salvia* gum samples (*p*<0.01) and *Salep* (*p*<0.05). differences were significant. According to Figure 3, the lowest (5.3) and highest (7.9) points of viscosity of ice cream containing *Salep* 0.1% and 0.2% *Salvia*gum is.

Liquefying rate

According to the results shown in TABLE 3, there are significant differences for samples *Salvia* (*p*<0.01) and *Salep* (*p*<0.05). Highest score (6.85) containing 0.05%*Salvia*seed gum ice cream and lowest (5.45) for theice cream containing *Salep*0.2%. score liquefying rate wirh increase the rate of condensation of stabilizers used in ice cream, low fat, reduced (Figure2).

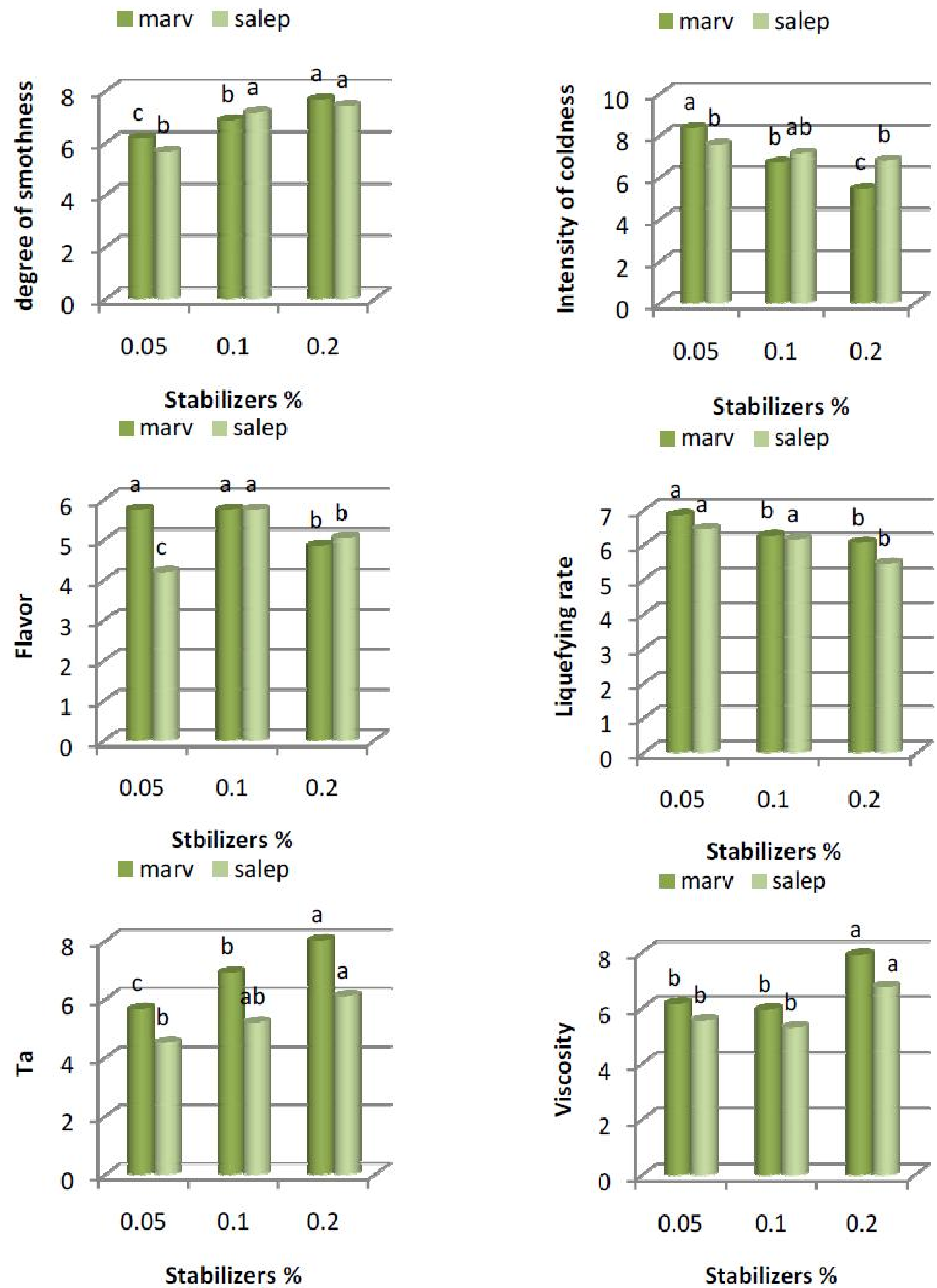

Figure 2 : Effect of type and concentration of the *Salvia* gum and *Salep* on the sensory properties of low-fat ice cream

Total acceptance

According to the results shown in TABLE 3, no significant differences for samples (*Salvia* (p<0.01)

Salep (p<0.05) there. Total acceptance rates between the range 4.5 to 8, respectively. Points for general admission increased by increasing the amount of stabilizer. Ice cream containing *Salvia* gum obtained higher scores in terms of total acceptance (Figure 2).

CONCLUSION

*Salvia*seed gum as a stabilizer and in three levels 0.05, 0.1 and 0.2 percent in the preparation of low fat ice cream, low fat ice cream has been used to improve the quality and sensory characteristics. The overall results of the physicochemical and sensory tests were significant differences (p<0.05) for samples showed low fat ice cream. The results showed that the use of *Salvia* seed gum in the low fat ice cream formulation as stabilizer and substitutes fat have positive effects on physicochemical and sensory properties of products. Considering to the positive effects of *Salvia* seed gum users in low fat ice cream and good functioning characteristics of the gum as stabilizer and fat substitutes, and also because of the expensive cost of production of fat substitutes used in the food industry, the gum was extracted and effect in different food products seem important. This gum is used as a fat substitute because the stabilizing role and the role fat plays an economical alternative.

REFERENCES

[1] M.M.Abdullah, M.E.Nadeem, N.Babar, G.A.Akhtar, M.Y.Ellahi; Preparation of functional low fat ice cream from buffalo milk fat-super-olein blends, Pakistant J.Zool.Supple.Ser., **9**, 219 **(2009)**.

[2] M.Abdullah, S.Rehman, H.Zubair, H.M.Saeed, S.Kousar, M.Shahid; Effect of skim milk in soymilk blend on the quality of ice cream, Pakistan Journal of Nutrition, **2**, 305-311 **(2003)**.

[3] S.Adapa, H.Dingeldein, K.A.Schmidt, T.J.Herald; Rheological properties of ice cream mixed and frozen ice creams containing fat and fat replacers, H.Dairy Sci., **83**, 2224 **(2000)**.

[4] D.B.Aime, S.D.Arntfield, L.J.Malcolmson, D.Ryland; Textural analysis of fat reduced vanilla ice-cream products, Food Res.Int, **34**, 237-246 **(2001)**.

[5] S.Ashish, A.Patel, H.Jana, D.Kishore, S.Aparanathi, V.Pinto; Evaluation sago as a functional ingredient in dietetic mango ice cream, J Food Sci.Technol., DOI: 10.1007/s13197-010-0119-9, **47(5)**, 582-585 **(2010)**..

[6] S.Bolliger, B.Kornbrust, H.D.Goff, B.W.Tharp, E.J.Windhab; Influence of emulsifiers on ice cream produced by convectional freezing and low-temperature extrusion processing, Inter.Dairy J., **10**, 497 **(2000)**.

[7] A.Bostan, S.M.A.Razavi, R.Farhoosh; Optimization of hydrocolloid extraction from wild sage seeds (*Salvia macrosiphon*) using response surface, International Journal of Food Properties, Doi: 10.1080/10942910903079247, **13(6)**, 1380-1390 **(2010)**.

[8] J.L.Chang, R.T.Marshall, H.Heymann; Casein micelles partially hydrolyzed by chamois to modify the texture of low fat ice cream, J.Dairy Sci., **78**, 2617 **(1995)**.

[9] J.M.Chauhan, S.Y.Lim, H.R.Powers, C.F.Ross, S.Clak; Low-fat ice cream flavor not modified by high hydrostatic pressure treatment of whey protein connectract, J.Dairy Sci., **93**, 1452 **(2010)**.

[10] N.Francy, B.Lopez, M.U.Jose, V.M.Sepulveda; Evalution of non fatsoild substitutes (NSI) in a hard dairy ice cream mix with vegetable fa, Vitae, Revista de la Facultad de QuimcaFarmaceutica., **19**, 197 **(2012)**.

[11] J.Giese; Fats, Oils and Fat Replacers, Food Tech., **50(4)**, 77-84 **(1996)**.

[12] H.D.Goff, E.Verespej, A.K.Smith; A study of fat and air structures in ice-cream, International Dairy Journal, **9**, 817-829 **(1999)**.

[13] N.Innocente, M.Biasutti, E.Venir, M.Spaziani, G.Marchesini; Effect of high-pressure homogenization on droplet size distribution and rheological properties of ice cream mixes, J.dairy Sci., **92**, 1864 **(2009)**.

[14] M.Jamshidi, N.Hamdami, Sh.Dokhani, J.Keramat; Single-and Multi-objective optimization of low fat ice cream formulation, based on genetic algorithms, J.Agr.Tech., **14**, 1285-1296 **(2012)**.

[15] R.A.M.Khalil, K.I.Blassy; The use modified date pulp fibers in functional low fat ice cream, Egypt.J.Dairy Sci., **39**, 275-283 **(2011)**.

[16] R.A.M.Khalil, H.E.Embaby; The use of jambul fruit (syzygiumcumini) as a source of natural antioxidants in functional low dat ice cream making, Egyptian J.Dairy Sci., ISSN: 0378-2700, **40**, 75-84 **(2012)**.

[17] W.Kirchhubel, H.Roth; Relatioship between overrun and sensory evalutionof ice cream, Bacher and Konditor, **26**, 259 **(1978)**.

[18] M.A.Kunna, K.A.Abdel Razig; Effect of some additves on the rheological and organoleptic properties of low fat ice cream during storage, Egyptian, J.Dairy.Sci., ISSN: 0378-2700, **42**, 81-87 **(2013)**..

[19] S.Y.Lim, B.G.Swanson, C.F.Ross, S.Clark; High hydrostatic pressure modification of whey protein concentrate for improved body and texture of low fat ice cream, J.Dairy Sci., **91**, 1308 **(2008)**.

[20] R.T.Marshall, W.S.Arbuckle; Ice cream.5th Edition, Aspen Pub, NY, 349 **(1996)**.

[21] S.M.A.Razavi, R.Farhoosh, A.Bostan; Functional properties od hydrocolloid exract of some Iranian seeds, Resesrch project No.1475, Unpublished report, FerdowsiUnivesity of Mashhad, Iran, **(2007)**.

[22] C.Soukoulis, E.Lyroni, C.Tzia; Sensory profiling and hedonic judgment of probiotic ice cream as function of hydrocolloids, yogurt and milk fat content, LWT.Food Sci.&Techn., **43**, 1351 **(2010)**.

[23] C.Soukoulis, D.Lebesi, C.Tzia; Enrichment of ice cream with dietary fibre: Effects on rheological properties, Ice crystallization and glass transition phenomena, Food Chemistry, **115**, 665-671 **(2009)**.

[24] T.Turgut, S.Cakmacki; Investigatiom of the possible use of probiotics in ice cream manufacture, Inter, J.of Gairy Techno., **62**, 444 **(2009)**.

[25] T.O.Yilsay, L.Yilmaz, A.A.Bayizit; The effect of using a whey protein fat replacer on textural and sensory characteristics of low-fat vanilla ice cream, Eur.Food Res.Technol., **2.22**, 171-175 **(2006)**.