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Physicochemical Characteristics Of Ice Cream Stabilized With Gum Arabic And Tartar Gum.

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Abstract

This study was conducted to evaluate physico-chemical characteristics of ice cream stabilized with gum arabic (*Acacia Senegal*) and tartar gum (S*terculia setigera*). Ice cream was manufacture by batch machine, gum Arabic and tartar gum were added to ice cream mix at three levels (0.25, 0.5, and 0.75%) and another sample without gum was prepared as control. pH, melting resistance, viscosity, total solids, moisture, protein, fat, ash content and acidity of ice cream were determined immediately after processing then after two, four and 6 months using AOAC methods. Results showed significant (P≤0.05) increase in total solids, protein, fat, ash, acidity, melting resistance and viscosity with increase in gum Arabic and Tatar gum concentration. Moisture content and pH values decreased significantly (P≤0.05). Protein, T.S, fat, and ash decreased significantly (P≤0.05) during storage. Melting points of control, samples stabilized with 0.75% gum Arabic and sample treated with 0.75% tartar, were 20.00, 24.35, and 24.34, respectively. The highest value for viscosity (3770cp) was observed in sample treated with 0.75% gum Arabic compared with control (2020cp). Ice cream samples treated with 0.25%,o.5%,0.75% gum Arabic had protein content of 5.04,5.37,5.57,while sample treated with tartar gum had 4.73,5.13,5.22%. Control sample had total solids of 37.92%, whereas samples treated with 0.25, 0.5, 0.75% gum Arabic and tartar gum were 38, 75, 39.19, 39.52 and 38.34, 39.22.39.88 respectively. The highest moisture content was 63.22% recorded for control sample, while the lowest one was 60.03% recorded for sample treated with 0.75% gum Arabic added at initial time. Acidity ranged from 0.22-0.26% for sample treated with gum Arabic and 0.24-0.27% for samples treated with tartar gum, while that of control sample was 0.21.The highest ash content was 0.85 for sample treated with tartar gum and 0.80 for control .This study concluded that Ice cream stabilized with each of gum Arabic and Tartar gum showed enhancement in melting point resistance, viscosity, higher protein,fat ash and total solid contents and a decrease in moisture and ph. Formulating ice cream with gum Arabic and tartar gum could enhance quality characteristics of the product.

Key words : Physico-chemical characteristics, ice cream ,gum Arabic ,tartar gum

Introduction:

Frozen desserts are the most popular desserts eaten in or out the home. They are much consumed and preferred products in the world due to their taste and availability. There are many types of desserts dairy and non-dairy, the dairy such as ice cream, sherbet, pudding, and frozen yoghurt. Dairy and non-dairy desserts are also famous and very widely consumed in Sudan (Elahi et al., 2002).Ice cream is an important component of the diet and a good source of proteins, fat, vitamins and minerals.It is nutritional and healthy product. Ice cream is prepared by pasteurization of mixture of milk, cream, and milk solids, fat, sugars, flavor, emulsifiers and stabilizers, homogenizing, cooling, aeration and freezing and hardening. Stabilizer is one of the most important ingredients in ice cream manufacture because it contributes significantly to physicochemical and sensory properties. Stabilizers reduce the amount of free water in the ice cream mix, which produces good body, smooth texture and slow meltdown (Martin, 2014). Stabilizers maintain homogeneity, control ice crystal growth during freezing process, increase stiffness, enhance whipping ability during aeration and prevent shrinkage during storage. Several factors are responsible for ice cream quality deterioration including quick melting down, weak texture, re-crystallization, and bacterial growth during storage. The majority of these defects could be prevented by incorporation of natural stabilizer in the mix at the optimum concentration. Gum is one of the important and common natural stabilizers. Gum Arabic is obtained as dried exudates from the stems and branches of Acacia Senegal trees known as hashab and acacia seyal trees known as talha (Thomas, 2011). It is considered as a prebiotic and emulsifier, thickener, and stabilizer in dairy products. It has use in dairy products as stabilizer in caramel, toffee, pastilles, cocktail mix, fruit juice and soft drink production (Thomas, 2011). Tartar gum is the dried exudates obtained from branches or stem of Sterculia tree (Hussein, 2006). The main constituents of Tatar gum are high molecular weight polysaccharides and their calcium, magnesium and potassium salts which yield galactose, arabinose, and glucuronic acid then hydrolyzed (Phillips and Williams, 2000). Tartar gum is universally accepted as one of the main contributing sources of the world’s commercial gums. Tartar tree is widespread evanescent species of champaign wood land of Sudan. It is found in several parts of Sudan, particularly Nuba Mountains, southern Kordofan, Blue Nile, and Red Sea Hills (El amin, 1990). Tatar gum is used as an emulsifier and stabilizer in the food industry textiles and a binder in pulp and paper making (Hussein, 2006). The effects of

industrial food additives may be harmful in the long run if one has constant exposure or accumulations such as kidney effects, cancer, cardio vascular diseases, gastrointestinal, joints, and acute damage to the nervous system. They are many studies conducted using gum Arabic as stabilizer in dairy product including ice cream, yoghurt, cheese, ice milk ,robe ,sherbet and so on.(Elhassan, 2017) found that, formulated ice cream with gum Arabic and tartar gum enhance the physicochemical properties and inhibit the bacterial growth. In addition, using 0.7% Arabic gum had the best appearance, flavor, iciness, smoothness and over all acceptability. Mehanna ,N and Mehanna(1989) ,and Monay (1987) showed that, the addition of gum Arabic as stabilizers enhanced the quality attributes of ice cream. Hassab Elnabi (2018) found that, used of gum Arabic in camel milk cheese gave the best palatability characteristics and good quality attributes.

The objective of this study was to formulate ice cream using gum Arabic and Tartar gum as natural stabilizers, evaluate the physicochemical attributes and determine shelf life of the product.

Material and Methods:

Materials

Skimmed milk powder was purchased from local market at Khartoum. Gum Arabic (GA) and tartar gum (TG) were obtained from Sudanese Gum Arabic Company, Khartoum. Sucrose, whipping cream, shortening, lecithin, and vanilla flavor were obtained from Dolsey factory, Khartoum.

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Preparation of gums

Gum samples were cleaned by hand manually to remove foreign particles, dried at room temperature, the samples were then ground using a mortar and pestle and kept in glass containers at room temperature until used.

Manufacture of ice cream

The dry materials, skimmed milk powder, cream, sugar, gum Arabic and tartar gum were added at three levels (0.25, 0.5, and 0.75%) then mixed with water, shortening, lecithin, and flavor were added also. They were blended, pasteurized at 78^{o}C for 30 seconds, homogenized, cooled at two stages (initial and second cooling), frozen, packaged in plastic cups and stored at -25^{o}C for six months. A control sample of ice cream was prepared without gums.

Proximate analysis

Total solids, moisture, protein, fat, ash, acidity, pH, viscosity and melting resistance were determined for all ice cream samples using AOAC methods (2005).

Statistical Analysis

The data obtained from different treatment were subjected to analysis of variance and Duncan's multiply range test to separate means (Steel and Torri 1980) using SAS program(Release 6- 03, 2002) to perform the general liner model (GLM) analysis.

Results and Discussion

Physical characteristics of ice cream stabilized with Gum Arabic and Tartar Gum

As shown in table1aSignificant differences in pH were observed among different treatment. Obviously, gum types and their concentrations significantly affect pH values of ice cream. Control sample recorded highest pH value 6.36. Samples treated with 0.25%, 0.5% and 0.75% Gum Arabic reported higher pH values (6.34, 6.31 and 6.28) compared with samples treated with Tatar gum which recorded 6.29, 6.25 and 6.23, respectively. These results are in agreement with that reported by Elhassan (2017) who found that the mean of pH value of ice cream treated with gum Arabic was 6.37 and that of sample treated with tartar gum was 6.30. Generally, pH values significantly ($P \leq 0.05$) decreased when storage period increased. At zero time the mean value of pH of ice sample was 6.40, after two month of storage the pH values mean decreased to 6.28, then to 6.24 at the end of six month storage period. This reduction could be attributed to the increase in titarable acidity of ice cream. Similar reduction was noticed by Rezaei *et al.*, (2011), Singh *et al*, (2014) and Singh *et al.*, (2006).

Table 2 shows Effect of gum Arabic and tartar gum on viscosity of ice cream. Viscosity of ice cream was significantly ($P \leq 0.05$) affected by gum levels. Sample containing 0.75% GA had the highest viscosity 3770.3cp, among all samples, which is in agreement with that of Elhassan, (2017). This could be due to increment in total solids by gum concentration. Stabilizers have water - holding capacity and can influence the rheological properties of ice cream mix as reported by Clarke (2004), Soukoulis and Tzia (2008) and Elhassan, (2017). Melting point increased as gum levels increased. Sample stabilized with 0.75% GA had the highest melting resistance 24.35% among all treatment. Soukoulis and Tzia (2008) found that, stabilizers can form sticky network in ice cream that leads to more resistance in melting. A significant ($P \leq 0.05$) decreased in meltdown resistance of all samples of ice cream during the six months of storage period was observed. These findings were in

agreement with the findings of Elhassan (2017), Singh *et al.* (2006) and Soukoulis *et al*, (2008).

Table 1: Effect of gum Arabic and tartar gum on pH values of ice cream

pH value		Storage (months)				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	6.5000^{a} (±0.11)	6.3400^{fg} (±0.16)	6.3133^{ij} (±0.26)	6.3000^{ij} (±0.10)	6.3633^{A}
	0.25	6.4400^{b} (±0.19)	6.3267^{gh} (±0.03)	6.3033 (±0.00)	6.2933^{jk} (±0.06)	6.3408^{B}
	o.5	6.3900^{d} (±0.13)	6.3233^{h} (±0.36)	6.2800^{kl} (±0.86)	6.2667^{l} (±0.90)	6.3150^{C}
	0.75	6.3633^{e} (±0.46)	6.3000^{ij} (±0.46)	6.2467^{m} (±0.89)	6.2400^{mno} (±0.90)	6.2875^{D}
Tartar gum	0.25	6.4200^{c} (±0.10)	6.2700^{l} (±0.02)	6.2433^{mn} (±0.00)	6.2300^{no} (±0.06)	6.2908^{D}
	0.5	6.3700^{e} (±0.46)	6.2267^{o} (±0.68)	6.2100^{p} (±0.36)	6.2033^{p} (±0.79)	6.2525^{E}
	0.75	6.3467^{f} (±0.18)	6.2067^{p} (±0.46)	6.2000^{p} (±0.46)	6.1800^{q} (±0.06)	6.2333^{F}
Storage means		6.4043^{A}	6.2848^{B}	6.2567^{C}	6.2448^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Table 2: Effect of gum Arabic and tartar gum on viscosity of ice cream

Viscosity(cp)		Storage (months)				Treatment means
Treatment		0	2	4	6	
	Level %					

Gum Arabic	0	2047^{b}	2016^{b}	2010^{b}	2010^{b}	2020.9^{B}
	0.25	3203^{b}	3123^{b}	3115^{b}	3108^{b}	3137.2^{B}
	0.5	3421^{b}	3375^{b}	3364^{b}	3328^{b}	3372.1^{AB}
	0.75	3850^{b}	3794^{b}	3736^{b}	3701^{b}	3770.3^{AB}
Tartar gum	0.25	3089^{b}	3067^{b}	3067^{b}	3050^{b}	3068.3^{B}
	0.5	3224^{b}	3207^{b}	3203^{b}	3158^{b}	3198.0^{AB}
	0.75	3359^{b}	3317^{b}	3306^{b}	3220	3275.5
Storage means		3170.4^{A}	3128.5^{B}	3114.4^{C}	3082.14^{D}	

Means ± SD. Means with the same superscript letters are not significantly different (P≥0.05).
Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Table 3: Effect of gum and tartar gum on melting resistance(%) of ice cream

Melting resistance		**Storage (months)**				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	20.130^{o} (±0.61)	20.067^{o} (±0.01)	20.000^{o} (±0.00)	19.837^{p} (±0.03)	20.008^{F}
	0.25	21.313^{j} (±0.09)	21.147^{k} (±0.57)	21.080^{kl} (±0.89)	20.447^{n} (±0.92)	20.997^{E}
	0.5	23.077^{f} (±0.31)	23.053^{f} (±0.35)	23.017^{f} (±0.01)	22.703^{g} (±0.21)	22.962^{B}
	0.75	24.770^{b} (±0.21)	24.273^{cd} (±0.61)	24.203^{d} (±.06)	24.153^{d} (±0.51)	24.350^{A}
Tartar Gum	0.25	20.713^{m} (±0.68)	20.110^{i} (±0.51)	20.033^{kl} (±0.67)	20.000^{l} (±0.89)	20.214^{D}
	0.5	23.077^{f} (±0.41)	23.009^{f} (±0.58)	23.000^{f} (±0.47)	22.173^{h} (±0.61)	22.813^{C}
	0.75	25.023^{a} (±0.66)	24.380^{c} (±0.21)	24.000^{e} (±0.24)	23.967^{e} (±0.62)	24.342^{A}
Storage means		22.586^{A}	22.291^{B}	22.1904^{C}	21.897^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Chemical characteristics of ice cream stabilized with gum Arabic and tartar gum

Table 4, shows results of effect of gum Arabic and tartar gum on total solids of ice cream. The results revealed that there were significant differences (p≤0.05) in T.S content among the different treatments of ice cream samples throughout six month. Control sample recorded the lowest total solids 37.92%, while the highest total solids 39.88%, recorded for sample stabilized with 0.75% Tartar gum. Similar results were found by Elhassan (2017) who reported that, the lowest value of T.S was found in control sample. Hassab Elnabi (2018) reported that addition of stabilizers increases the solids content of cheese. Mekanna and Mehanna(1989) and Monay (1987) showed that addition of stabilizers increased the solids content. Generally, total solids decreased significantly (p≤0.05) with storage period. Samples at initial time, two month , four month and six month of storage recorded T.S of 39.55%, 39.11%%, 38.72% and 38.53%, respectively. These results are in agreement with that of Earl and Tracy (1960) who found that the total solids of ice cream decreased significantly as storage time progressed.

Table 4: Effect of AG and tartar gum on Total solids of ice cream

T.S		Storage (months)				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	38.616^{a} (±0.20)	37.763^{h} (±0.17)	37.713^{h} (±0.06)	37.613^{i} (±0.23)	37.92^{G}
	0.25	39.720^{c} (±0.17)	38.973^{k} (±0.27)	38.330^{l} (±0.14)	38.000^{l} (±0.48)	38.75^{E}
	0.5	39.927^{e} (±0.25)	39.587^{m} (±0.98)	38.647^{n} (±0.23)	38.607^{o} (±0.29)	39.19^{C}
	0.75	39.967^{g} (±0.56)	39.610^{o} (±0.66)	39.600^{op} (±0.78)	39.013^{q} (±0.90)	39.52^{B}
	0.25	39.327^{b} (±0.10)	38.677^{i} (±0.13)	37.724^{g} (±0.24)	37.650^{h} (±0.47)	38.34^{F}

Tartar Gum	0.5	39.350^{d} (±0.16)	39.297^{l} (±0.21)	39.190^{m} (±0.05)	39.057^{mn} (±0.96)	39.22^{D}
	0.75	39.990^{f} (±0.34)	39.890^{o} (±0.46)	39.853^{p} (±0.68)	39.787^{pq} (±0.38)	39.88^{A}
Storage means		39.550^{A}	39.110^{B}	38.722^{C}	38.532^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Table 5 shows results of effect of gum Arabic and tartar gum on moisture content of ice cream. There are significant differences (p≤0.05) in moisture content among different treatments. Control sample had the highest mean value of moisture content (62.29%), while samples treated with gum Arabic and tartar gum recorded mean values of 60.84, and 62.09%, respectively. These could be attributes to the increase of total solids. The results showed that moisture content decreased with the increase in the levels of addition of the two types of gum. Similar results were reported by Ahmed (2006). Moisture content also increased with increase of storage period up to six months.

Table 5: Effect of gum Arabic and tartar gum on moisture content of ice cream

Treatment		Storage (months)				Treatment means	Mean
	Level	0	2	4	6		
Gum Arabic	Untreated	61.393^{i} (±0.57)	62.267^{j} (±0.10)	62.297^{h} (±0.50)	63.220^{a} (±0.09)	62.29^{A}	60.84
	0.25	60.280^{q} (±0.27)	61.027^{n} (±0.03)	61.670^{l} (±0.27)	62.020^{k} (±0.53)	61.26^{E}	
	0.5	60.073^{e} (±0.02)	60.413^{m} (±0.06)	61.353^{mn} (±0.02)	61.393^{n} (±0.53)	60.81^{F}	
	0.75	60.033^{g} (±0.02)	60.390^{op} (±0.52)	60.400^{pq} (±0.08)	60.897^{q} (±0.04)	60.78^{FG}	
Tatar Gum	0.25	61.389^{b} (±0.50)	62.234^{j} (±0.46)	62.282^{j} (±0.46)	62.780^{j} (±0.27)	62.16^{B}	62.09
	0.5	61.369^{d}	62.229^{l}	62.279^{m}	62.378^{mn}	62.07^{C}	

		(±0.51)	(±0.89)	(±0.63)	(±0.46)		
	0.75	61.358^{o} (±0.03)	62.219^{opq} (±0.06)	62.269^{pq} (±0.27)	62.369^{f} (±0.24)	62.05^{CD}	
	Storage means	60.84^{D}	61.54^{C}	61.79^{B}	62.23^{A}		

- Means ± SD
- Means in the same row with different superscript capital letters are significantly different (P≤0.05).
- Means in the same column with different superscript capital letters are significantly different (p≤0.05).

Table 6 shows acidity of ice cream during storage. There were significant differences (p≤0.05) in acidity of different treatments. Control sample had acidity value of 0.21, whereas that of samples treated with different levels of gum Arabic and tartar gum ranged from 0.22% to 0.26 and 0.24 to 0.27, respectively .These results were in agreements with those of Butt et al. (1999) who found acidity range from 0.20 to 0.23. Samples formulated by gum Arabic had slightly lower acidity (0.24) compared with samples formulated with tartar gum (0.25). Acidity values of all ice cream samples increased during storage period. It increased from 0.22 to 0.25 during six month of storage. The results of this study are similar to those reported by Abdullah et al., (2003), Murtaz et al., (2004) and Elhassan (2017) who found that there was a gradual increase in acidity during storage period of ice cream.

Table 6: Effect of AG and tartar gum on acidity of ice cream

Acidity		Storage (months)					
Treatment		0	2	4	6	Treatment means	
	Level (%)						
Gum Arabic	Untreated	0.206^{m} (±0.11)	0.210^{lm} (±0.26)	0.223^{jkl} (±0.10)	0.230^{ijk} (±0.02)	0.217^{F}	0.243
	0.25	0.213^{lm} (±0.07)	0.220^{klm} (±0.26)	0.233^{ijk} (±0.18)	0.236^{hij} (±0.36)	0.225^{E}	

	.0.5	0.220^{klm} (±0.79)	0.240^{ghi} (±0.22)	0.253^{def} (±0.25)	0.256^{cdef} (±0.14)	0.242^{D}	
	0.75	0.240^{ghi} (±0.17)	0.266^{abcd} (±0.19)	0.270^{abc} (±0.00)	0.270^{abc} (±0.08)	0.261^{B}	
Tartar gum	0.25	0.223^{jkl} (±0.11)	0.260^{cde} (±0.16)	0.243^{fghi} (±0.14)	0.250^{efgh} (±0.18)	0.244^{D}	0.255
	0.5	0.236^{hij} (±0.16)	0.250^{efgh} (±0.36)	0.260^{cde} (±0.26)	0.263^{cde} (±0.57)	0.252^{C}	
	0.75	0.256^{cde} (±0.10)	0.270^{abc} (±0.4)	0.276^{ab} (±0.46)	0.280^{a} (±0.36)	0.270^{A}	
Storage means		0.228^{C}	0.245^{B}	0.251^{A}	0.255^{A}		

- Means ± SD
- Means with the same superscript letters are not significantly different (P≥0.05).
- Means in the same row with different superscript capital letters are significantly different (P≤0.05).
- Means in the same column with the different superscript capital letters are significantly different (p≤0.05).

Results of protein content of ice cream are shown in table 7, increment of gum level caused increase in protein content of ice cream. Samples containing 0.25%, 0.5% and 0.75% gum Arabic and tartar gum had mean protein content of 5.04, 5.37, 5.57%, and 4.73, 5.13, 5.22, respectively. However, gum type significantly (P≤0.05) effected protein content of ice cream. Similar trend was observed by Hassab Elnabi (2018) who reported that, protein content increased as gum levels increased. Samples treated with GA were found to be higher in protein content compared with samples treated with TG. Protein content of all ice cream samples decreased during storage period. At zero time ice cream samples had protein content with mean 5.2%, while, after six months of storage had mean protein content of 4.8%. The decrease could be attributed to activity of some micro organism, consistent with a similar trend observed by Elhassan (2017).

Table 7: Effect of AG and tartar gum on protein content of ice cream

Protein		Storage (months)				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	4.290^{s} (±0.26)	4.280^{k} (±0.11)	4.210^{l} (±0.18)	4.200^{l} (±0.89)	4.245^{G}
	0.25	5.113^{q} (±0.56)	5.046^{gh} (±0.46)	5.006^{h} (±0.46)	5.000^{h} (±0.39)	5.041^{E}
	0.5	5.356^{n} (±0.06)	5.356^{cd} (±0.56)	5.256^{e} (±0.06)	5.223^{e} (±0.10)	5.372^{B}
	0.75	5.866^{m} (±0.05)	5.576^{a} (±0.04)	5.473^{b} (±0.26)	5.400^{c} (±0.17)	5.579^{A}
Tartar Gum	0.25	5.010^{r} (±0.19)	4.696^{i} (±0.00)	4.626^{j} (±0.02)	4.593^{j} (±0.06)	4.7316^{F}
	0.5	5.356^{p} (±0.06)	5.123^{f} (±0.18)	5.040^{h} (±0.36)	5.001^{h} (±0.36)	5.131^{D}
	0.75	5.450 (±0.67)	5.326^{d} (±0.57)	5.100^{fg} (±0.57)	5.013^{h} (±0.58)	5.222^{C}
Storage means		5.206^{A}	5.061^{B}	4.890^{C}	4.868^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Table 8 shows results of effect of gum Arabic and tartar gum on fat content of ice cream. Significant differences (P≤0.05) in fat content among different treatments were evident. As gum concentration increased fat content of ice cream increased regardless of gum type. Similar observation was reported by Elhassan (2017) who found that, the fat content of ice cream increased as gum concentration increased from 9.09% at level 0.3% to reach 9.014%. Hassab Elnabi (2018) reported that, formulated cheese with Arabic gum increased fat content of the final product. Fat content of ice cream decreased significantly (P≤0.05) with storage period from 8.69% initially to 8.48% at second month of storage, then

decreased to reach 8.30% at the sixth month of storage. These could be attributed to, the microbial activities during storage period which resulted in lipolysis, consistent with a similar phenomenon noticed by Elhassan (2017); Hassab Elnabi (2018) and Clarke (2004).

Table 8: Effect of AG and tartar gum on fat content of ice cream

Fat		Storage (months)				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	8.220^{q} (±0.18)	8.033^{kl} (±0.10)	7.990^{lm} (±0.06)	7.923^{m} (±0.02)	8.041^{G}
	0.25	8.833^{o} (±0.04)	8.476^{ef} (±0.26)	8.323^{hi} (±0.88)	8.280^{i} (±0.66)	8.478^{E}
	0.5	8.953^{n} (±0.66)	8.606^{cd} (±0.03)	8.400^{fgh} (±0.10)	8.333^{hi} (±0.05)	8.573^{C}
	0.75	8.983^{n} (±0.97)	8.856^{a} (±0.69)	8.720^{b} (±0.90)	8.653^{bc} (±0.26)	8.654^{B}
Tartar Gum	0.25	8.230^{p} (±0.09)	8.160^{j} (±0.03)	8.076^{k} (±0.26)	8.056^{kl} (±0.14)	8.130^{F}
	0.5	8.790^{o} (±0.10)	8.536^{de} (±0.06)	8.436^{fg} (±0.03)	8.370^{gh} (±0.06)	8.533^{D}
	0.75	8.830^{o} (±0.12)	8.723^{b} (±0.15)	8.613^{cd} (±0.18)	8.546^{de} (±0.96)	8.678^{A}
Storage means		8.691^{A}	8.486^{B}	8.311^{C}	8.309^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Table 9 shows effect of gum Arabic and tartar gum on ash content of ice cream. Significant (P≤0.05) differences were noticed among different treatment. Ash content of gum supplemented ice cream is significantly (P≤0.05) higher than of control. The highest ash content was 0.8546 % in ice cream samples stabilized by Tartar gum while that of

samples stabilized by Arabic gum was 0.8504%. As gum levels increased ash content also increased, where samples treated with 0.25%, 0.5% and 0.75% Tartar gum had ash content of 0.8368%, 0.8600% and 0.8672%, respectively. This could be attributed to the presence of some minerals such as calcium in the gums. These results were in agreement with the findings of Hamad *et al.,* (2013) and Elhassan (2017) who reported that ash content of samples increased with the increase in gum powder levels. Ahmed (2006) found the ash content in the range from 0.62% to 0.88%, lower values were reported by Murtaza *et al.,* (2004) who found that ash content ranged from 0.47% to 0.72%. Storage period had a significant effect ($P \leq 0.05$) on the ash content of all ice cream samples. Ice cream ash content decrease with the increase of storage periods, this could be attributed to increase of bacterial growth, and similar observation was reported by Murtaza *et al.,* (2004); Elhassan (2017); and Hamad *et al.,* (2013).

Table 9: Effect of gum Arabic and tartar gum on ash content of ice cream

Ash		Storage (months)				
Treatment		0	2	4	6	Treatment means
	Level (%)					
Gum Arabic	Untreated	0.846^{pq} (±0.05)	0.803^{g} (±0.61)	0.783^{hi} (±0.81)	0.7700^{ij} (±0.91)	0.800^{G}
	0.25	0.863^{p} (±0.00)	0.840^{f} (±0.06)	0.800^{gh} (±0.78)	0.7933^{gh} (±0.90)	0.824^{F}
	0.5	0.864^{n} (±0.06)	0.860^{de} (±0.07)	0.860^{de} (±0.71)	0.8467^{ef} (±0.91)	0.857^{D}
	7.5	0.873^{m} (±0.00)	0.870^{bc} (±0.07)	0.870^{bcd} (±0.71)	0.8633^{cde} (±0.96)	0.869^{A}
Tartar Gum	0.25	0.860^{q} (±0.06)	0.860^{de} (±0.08)	0.853^{ef} (±0.81)	0.7733^{k} (±0.00)	0.836^{E}
	0.5	0.896^{o} (±0.00)	0.890^{ab} (±0.23)	0.873^{bcd} (±0.61)	0.7800^{j} (±0.81)	0.860^{C}
	0.75	0.896^{l} (±0.71)	0.898^{a} (±0.66)	0.874^{ab} (±0.79)	0.800^{gh} (±0.82)	0.867^{B}

Storage means	0.871^{A}	0.860^{B}	0.844^{C}	0.803^{D}	

Means ± SD

Means with the same superscript letters are not significantly different (P≥0.05).

Means in the same row with the different superscript capital letters are significantly different (P≤0.05).

Conclusion

The study concluded that, Formulated ice cream with gum arabic and tartar gum enhance physico-chemical characteristics off ice cream. Further research is needed to develop the product and optimize gums concentration and blends.

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