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Quality properties of set yoghurt as affected by types of *Acacia* gum and storage period

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Abstract: The effect of types of *Acacia* gums added at the level of 0.3%, and storage periods on quality properties of set yoghurt prepared using cow milk was investigated. The types of Acacia gums included *Acacia senegal*, *Acacia leata*, *Acacia polyacantha*, *Acacia seyal* var. *seyal* and *Acacia seyal* var. *fistula* were used for stabilizing the texture of the set yoghurt. Starter culture (5%) was added after the pasteurization of the milk at 85°C for 10 minutes. The milk was incubated at 45°C for four hours, thereafter cooled to a temperature of 6±2°C,and stored for 20 days. The physicochemical, rheological properties, minerals content and acceptability were determined at storage intervals of 0, 4, 8, 12, 16, and 20 days. The physicochemical determinations revealed that, all test samples recorded decrease in pH-values that occurred during all storage intervals where the highest value (4.18) was recorded by the sample treated with *Acacia leata* and the lowest (3.62) was recorded by the control. The addition of acacia gums has significantly (P≤ 0.05) lower levels of the titratable acidity in all samples of set yoghurt compared to the control. The test sample of set yoghurt treated with *containing Acacia leata* has recorded the highest (19.25%) for the total solids, protein (4.22%) and ash (1.21%). The highest fat content (3.41%) was obtained by yoghurt containing *Acacia senegal*. The viscosity of the control sample expressed the lowest value being (2116 cps) while the highest (2505 cps) was obtained by set yoghurt treated with *Acacia senegal*. The results of the rheological analyses indicated that, the control sample has provided the highest wheying-off and synersis (0.92 ml, 2.98%) while the lowest (0.38 ml, 1.85% respectively) were given by the gum of the acacia leata. However, little increase in the volume of the wheying-off and synersis were obtained in all test samples as the storage period progressed. All types of *Acacia* gums have invariably caused an increase in phosphorus content of all samples until the day 8 of storage period. The highest value (122.48 mg/100g) being for the samples treated with the *Acacia* gum, while the lowest value (94.40 mg/100g) for the control. The *senegal* gum had imposed similar increasing trends of calcium and magnesium recording the highest values (192.30 and 194.73 mg/100g respectively), while the control gave the lowest values (141.73 and 129.74 mg/100g respectively). Generally, the contents of the minerals determined in yoghurt have decreased during storage periods. For acceptability, the use of *leata* gum *a* manifested the best appearance (5.50), texture (5.77), flavour (5.97), and acceptability (5.78), followed by *Acacia senegal* (5.45,

5.73, 5.95 and 5.74), *Acacia polyacantha* (5.28, 5.57, 5.75 and 5.75), *Acacia seyal* var. *seyal* (4.98, 5.50, 4.43and 5.31), *Acacia seyal* var.*fistula* (4.93, 5.46, 45.40, 5.30) and finally the control (3.98, 4.86, 5.00 and 4.67). The storage period affected the acceptability of set yoghurt in terms of appearance, texture and overall acceptability in that the three sensory parameters gave the best qualities at the beginning of the storage period and the worst at the end. Regarding the flavour, remarkable development was observed after 12 days from the beginning of the storage period by recording the highest value (5.94), thereafter, reached the lowest level (4.83) at the end of the storage period.

Keywords: Set yoghurt , Acacia gum , physicochemical, acceptability, storage period.

Introduction

Fermentation is one of the old and safety methods for preserving milk. The increase in acidity consequent to fermentation results in products such as yoghurt, quarg, labneh, kefir and koumiss, which are bacteriological stable under refrigerated conditions and free from pathogens,(Tamime and Robinson, 1999). Fermented dairy foods have long been considered safe and nutritional. The health benefits elicited by lactic acid bacteria (LAB) involved in the production of these foods were the primary reason to associate the consumption of yoghurt. The lactic acid lowers the pH and makes it start and causes the milk protein to thicken. The fermented milk makes yoghurt easily digestible (Lourens and Vilieon, 2001).

Yoghurt and other fermented dairy products were made by fermentation of milk using a mixed culture of *Thermophilic lactic acid* bacteria, (Klose and Glicksman ,1975). Yoghurt is perhaps the oldest fermented milk product known and it is consumed by large segments of population either as a part of diet or as refreshing beverage, because it's a nutritionally balanced food containing almost all the nutrients present in milk; but in more label from that believed yoghurt has valuable therapeutic properties and helps curing gastrointestinal disorders (Graive, 1984) .

Wide ranges of stabilizers are currently used in dairy industry. Grounds and stabilizers are widely used in yoghurt production, and commonly used in cultured products to control texture and reduce whey separation; these include locust bean gum, xanthan gum, carrageen, guar gum, gum Arabic, gelatin, pectin and agar. In yoghurt production, they are introduced into milk before pasteurization and culturing. The type of stabilizer is chosen based on the type of milk, processing conditions, solubility, legal standards and the properties of the stabilizer for stirred yoghurts.

Exudates gums are amongst the oldest natural gums: about 5,000 years ago they were already being used as thickening and stabilizing agents(Philips and Williams 2001). The gum Arabic has been used as stabilizer in a wide variety of dairy products including ice cream, ice milk, sherbets, ice pops, water ices, chocolate milk drink, pudding, cottage cheese, cream cheese spread, processed cheese and yoghurt. The main reason for the use of gum Arabic in these products is water-absorbing capacities (Aysel and Meral, 2003).

The objective of this work is to study the effect of types of acacia gum (*Acacia senegal*, *Acacia leata*, *Acacia polyacantha*, *Acacia seyal* var.*seyal*, *Acaia seyal* var. fistula) as a stabilizer onquality properties of set yoghurt during storage.

Material and Methods

Milk: Fresh raw cow's milk was obtained from Khartoum Dairy Products Company (KDPC).

Gum Arabic: Five types of Acacia gum (*Acacia Senegal*, *Acacia leata*, *Acacia polyacantha*, *Acacia seyal* var.*seyal*, *Acaciaseyal* var. *fistula*) were obtained from the gum Arabic Company Ltd.

Starter culture and yoghurt cups: The starter culture *Lactobacillus bulgaricus* and *Streptococcus thermohpilus* were obtained from Khartoum Dairy Products Company Ltd. Plastic cups (250 ml size) were purchased from the local market.

Methods

Preparation and manufacture of yoghurt: Five plastic containers were selected in which fresh milk was kept in equal volumes after being filtered from impurities. One out of five kinds of gums, namely, *Acacia senegal*, *Acacia leata*, *Acacia polyacantha*, *Acacia seyal* var seyal, and *Acacia seyal* var.fistula, was added to the five milk samples at a rate of 0.3% of the milk. The mixture was pasteurized at 85°C for 10 minutes, and then cooled to 45°C. Starter culture at a rate of 5% of the milk volume was added in the forms of (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*). There after the milk mixture was placed into Plastic cups (250 ml size) and kept in an incubater at 45°C for 3-4 hours. The cups were transefered to refrigerator and stored in a temperature of 10°C for 0, 4, 8, 12, 16 and 20 days intervals. Determinations were carried out for physicochemical, rheological, mineral content and organoleptic qualities.

Physicochemical analysis:
Total solids,titratable acidity and protein according to AOAC (1990). Fat determined by Gerber method according to Bradley *et al*., (1992),pH value using digital pH meter model A00567 H. Germany, The viscosity using a digital Hakke viscometer.

Rheological properties: Wheying–off was measured by sucking the water on the surface of the curd and pouring in a graduated cylinder, while synersis was measured according the method described by Lucy and Singh (1997).

Minerals content:
Calcium, magnesium and phosphorous contents were determined according to Atomic Absorption Spectrometer (Perkin Elmer, 1994).

Sensory evaluation:
Ten panelists from the Department of Food Science and Technology of AL Zaeim AL AzhariUniversity were chosen to judge on the quality of yoghurt in term of appearance, texture, flavour and acceptability. The sensory evaluation was evaluated by scoring procedure, hedonic scale as described by Ihekoronye and Ngoddy (1985).

Statistical analysis:
The statistical analysis was performed using SAS (1997) system. Meanswere separation using Duncan's Multiple Range Test.

Results and Discussion Physicochemical properties pH -value:
Table 1. shows the effect of type of acacia gum on pH-values of set yoghurt. The highest pH-value (4.18) by sample (C), and the lowest (3.62) by sample (A), while the other samples ranked in intermediate positions ($P \leq 0.05$). Table 2. show the effect of storage period on pH-value. The highest value ($P \leq 0.05$) was obtained at the beginning of the storage period (4.23), while the lowest (3.60) was obtained at the end. The pH-values were decreased progressively due to excessive sugar fermentation and presence of lactic acid (Galal *et al*., 2004 and Gouda *et al*., 2004.; El-Shibiny *et al*. (1979) and Mohammed (2008). Titratable acidity: Table1. shows the effect of type of acacia gum on titratable acidity of set yoghurt. The highest value (1.31%) by sample (A) and the lowest value (1.16%) by sample (C), while the other samples ranked in an intermediate positions ($P \leq 0.05$). Table 2. show the effect of storage period on titratable acidity of set yoghurt. The highest value ($P \leq 0.05$) was

obtained at the end of the storage period(1.73%) and the lowest value(0. 97%) at the beginning of the storageperiod (P≤0.05), titratable acidity in all samples increased progressively duringstorage period (Galal *etal*., 2004and Gouda *et al*., 2004), it refers to an increase in lactic acid by starter culture.

Total solid content: Table 1. shows the effect of type of acacia gum on total solids content of set yoghurt. The highest total solid (19.25%) by sample (C) and the lowest (18.33%) by sample (A), while the other samples ranked in intermediate positions (P≤0.05).

Table 2. show the effect of storage period on total solids content of set yoghurt. The highest value (P≤ 0.05) was obtained at the beginning of the storage period (19.15%), while the lowest (14.10%) was obtained at the end. Tamime and Deeth (1980) stated that, the change in the total solids due to lipolytic effect of yoghurt culture. Abdel-Salam *et al*., (1996) found that, the total solids content decreased during storage period, a decrease in all samples due to lactose fermentation, protein and fat hydrolysis with formation of volatile substance. Abdel-Salam *et al*., (1996) reported that, the addition of stabilizer had a negligible effect on the total solids content of fresh yoghurt, the total solids content of yoghurt from the different treatments decreased during storage.

Protein content: Table 1. shows the effect of type of acacia gum on protein content of set yoghurt. The highest value (4.22%) by sample (C) and the lowest (3.43%) by sample (A), while the other samples ranked in an intermediate positions (P≤0.05). Table 2. show the effect of storage period on protein content of set yoghurt. The highest value (4.42%) was obtained at the beginning of the storage period (P≤0.05) while the lowest (3.00%) at the end. The protein content during storage period decreased in all samples refer to decrease in total solids content during storage period and breakdown of amino acids by starter culture (Galal *et al*., 2004). Mohmmed (2008) found that, the protein content decreased during storage period.

Fat content: Table 1. shows the effect of type of Acacia gum on fat content of set yoghurt. The highest value (3.41%) by sample (B) and the lowest (2.92%) by sample (A), while the other samples ranked in an intermediate positions (P≤0.05). Table 2. show the effect of storage period on fat content of set yoghurt. The highest value (3.35%) was obtained at the beginning of the storage period (P≤0.05), while the lowest (2.19%) at the end. Abdel-Salam *et al*. (1996) found that, the fat content slightly decreased due to fat hydrolysis and liberation of free acids that escape determination by Girber method. Tamime and Deeth (1980) reported a decrease in fat content of yoghurt during storage period due to lipolysis in yoghurt .

Ash content: Table 1. shows the effect of type of acacia gum on ash content of set yoghurt. The highest value (1.21%) by sample (B), and the lowest (0.61%) by sample (A), while the other samples ranked in an intermediate position (P≤0.05). Table 2. show the effect of storage period on ash content of set yoghurt. The highest value (1.18%) was obtained at the beginning of the storage period, while the lowest (0.75%) at the end (P≤0.05).During storage period, the ash content decreased for all samples due to increase in moisture content of yoghurt that led to dilution of TS (FSA, 2002 and Galal *et al*., 2004). Mohammed (2008) found that, the ash content of set yoghurt decreased during storage period. The ash content decreased with the progress of storage period (Donkor *et al*., 2005).

Viscosity: Table 1. shows the effect of type of acacia gum on viscosity of set yoghurt. The highest value (2505 cps) was obtained by sample (B), and the lowest (2116 cps) was obtained by sample (A), while the other samples ranked in an intermediate positions (P≤0.05).Table 2. show the effect of storage period on viscosity of set yoghurt. The highest value (2591 cps) was obtained at the beginning

of the storage period (P≤0.05), while the lowest (2262 cps) was obtained at the end (P≤0.05). Latorre et al.,(2003) found theviscosity of set yoghurt decreased during storage period.

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Table 1. Effect of type of Acacia gum on physicochemical properties of set yoghurt

Parameter	Type of acacia gum					
	A	B	C	D	E	F
pH value	3.62^{e}±0.31	4.16^{b}±0.41	4.18^{a}±0.35	4.10^{c}±0.30	4.00^{cd}±0.42	3.93^{d}±0.40
Titratable acidity (%lactic acid)	1.31^{a}±0.12	1.19^{c}±0.38	1.16^{c}±0.40	1.25^{b}±0.36	1.28^{b}±0.42	1.29^{b}±0.41
Total solids (%)	18.33^{d}±0.31	19.00^{b}±0.09	19.25^{a}±0.12	19.15^{ab}±0.11	18.72^{c}±0.13	18.69^{cd}±0.11
Protein content (%)	3.43^{d}±0.31	4.13^{a}±0.40	4.22^{a}±0.50	3.98^{c}±0.45	3.45^{cd}±0.39	3.50^{d}±0.30
Fat content (%)	2.92^{e}±0.31	3.41^{a}±0.16	3.33^{bc}±0.15	3.22^{b}±0.16	3.16^{cd}±0.18	3.11^{c}±0.20
Ash content (%)	0.61^{d}±0.31	1.21^{a}±0.16	1.13^{ab}±0.07	1.06^{b}±0.11	0.71^{cd}±0.91	0.91^{c}±0.11
Viscosity (cps)	2116e±0.12	2505a±0.11	2461b±0.14	2347c±0.12	2313d±0.18	2348c±0.14

*Means± SD in the same row having different superscript letters are significantly different (P≤0.05).

A: Set yoghurt without Acacia gum (control).
B: Set yoghurt with *Acacia senegal*.
C: Set yoghurt with *Acacia leata*.
D: Set yoghurt with *Acacia polyacantha*.
E: Set yoghurt with *Acacia seyal*.
F: Set yoghurt with *Acacia fistula*.

Table 2. Effect of storage period on physicochemical properties of set yoghurt

Parameter	Storage period (days)					
	0	**4**	**8**	**12**	**16**	**20**
pH value	4.23^{a}±0.05	4.12^{ab}±0.13	3.96^{b}±0.12	3.85^{b}±0.07	3.73^{bc}±0.11	3.60^{c}±0.09
Titratable acidity (% as lactic acid)	0.97^{d}±0.01	1.07^{cd}±0.04	1.19^{c}±0.08	1.30^{b}±0.13	1.40^{b}±0.08	1.73^{a}±0.07
Total solids (%)	19.25^{a}±0.03	18.21^{a}±0.11	17.33^{b}±0.07	16.87^{c}±0.07	15.23^{cd}±0.11	14.10^{d}±0.08
Protein content (%)	4.42^{a}±0.13	4.19^{ab}±0.15	3.92^{b}±0.11	3.55^{c}±0.07	3.43^{cd}±0.12	3.00^{d}±0.13
Fat content (%)	3.35^{a}±0.10	3.30^{ab}±0.12	3.23^{b}±0.10	3.15^{bc}±0.11	3.19^{c}±0.12	2.19^{d}±0.13
Ash content (%)	1.18^{a}±0.31	1.11^{ab}±0.07	1.01^{b}±0.11	0.91^{c}±0.12	0.83^{cd}±0.12	0.75^{d}±0.13
Viscosity (cps)	2591^{e}±0.04	2391^{a}±0.12	2367^{bc}±0.08	2350^{cd}±0.07	2330^{d}±0.12	2262^{e}±0.07

*Means± SD in the same row having different superscript letters are significantly different (P≤0.05).

Rehological properties of set yoghurt

Wheying-off: Table 3. shows the effect of type of acacia gum on wheying-off of set yoghurt. The highest value (0.92 ml) by sample (A), and the lowest (0.38ml) by sample (C) while the other samples ranked in an intermediate positions (P≤0.05).Table 4. show the effect of storage period on wheying off of set yoghurt. The highest (0.71ml) was obtained at the end of the storage period and the lowest value (0.00 ml) was obtained at the beginning (P≤0.05). Ibrahim *et al*. (1989) reported that, the amount of separated whey from yoghurt samples ranged from 0.5 ml to 2.3 ml, it increased through storage without specific trend in the rate of increase. Excessive wheying-off is certainly an objectionable criteria and may be considered as a resent of poor quality yoghurt or lack of freshness. Latorre *et al.*, (2003) reported that, the curd tension of yoghurt was greatly affected by the type and concentration of stabilizer used.

Synersis: Table 3. shows the effect of type of Acacia gum on synersis of set yoghurt. The highest value (2.98%) by sample (A) and the lowest (1.85%) by sample (C), while the other samples ranked in an intermediate position (P≤ 0.05). Table 4. show the effect of storage period on synersis of set yoghurt. The highest value (3.40%) was obtained at the end of the storage period, while the lowest (0.0%) was obtained at the beginning (P≤ 0.05). El-Nagar and Shenana (1998) found that, the synersis increased during storage period. Livia (1981) found that, there was less variation in synersis of different samples of yoghurt compared to dahi due to presence of stabilizer used in manufacture of yoghurt.

Minerals content

Calcium content: Table 5. shows the effect of type of acacia gum on calcium content of set yoghurt. The highest value (192.30 mg/100g) by sample (B), and the lowest (141.73 mg/100g) by sample (A), while the other samples ranked in an intermediate position (P≤0.05).Table 6. show the effect of storage period on calcium content of set yoghurt. The highest value (164.38 mg/100g) was obtained at the beginning of the storage period and the lowest (163.25 mg/100g) at the end. Zehra and Hassan (2008) found the calcium content decreased during storage period. Hidiroglou and Proulx (1982) reported that, milk Ca content was high during the first day of storage, decreasing sharply at 2 nd day and then dropping gradually when storage progressed.

Phosphours content: Table 5. shows the effect of type of acacia gum on phosphours content of set yoghurt. The highest value (122.48 mg/100g) by sample (B) and the lowest (94.40 mg/100g) by sample (A), while the other samples ranked in an intermediate position (P≤0.05). Table 6. show the effect of storage period on phosphours content of set yoghurt. The highest value (105.39 mg/100g) was obtained at 8 days of storage period (P≤0.05), while the lowest (85.48 mg/100g) was obtained at the beginning of the storage (P≤0.05). The phosphours content increased during storage period to 8 days of storage, whereas decrease to the end of the storage period. Zehra and Hassan (2008) found that, the phosphour content increased during storage period. Hidiroglou and Proulx (1982) reported that, milk P content was high during the first day of storage, decreasing sharply at 2nd day and then dropping gradually when storage progressed.

Table 3: Effect of type of Acacia gum on wheying off and synersis of set yoghurt

Item	Type of Acacia gum					
	A	B	C	D	E	F
Wheying off (ml)	0.92^{a}±0.04	0.45^{d}±0.01	0.38^{e}±0.08	0.48^{b}±0.13	0.55^{bc}±0.08	0.52^{cd}±0.08
Synersis (%)	2.98^{a}±0.03	2.13^{d}±0.11	1.85^{e}±0.07	2.16^{cd}±0.07	2.68^{b}±0.11	2.30^{bc}±0.08

*Means±SD in the same row having different superscript letters are significantly different (P≤0.05.

A: set yoghurt without Acacia gum (control).
B: Set yoghurt with *Acacia senegal*.
C: Set yoghurt with *Acacia leata*.
D: Set yoghurt with *Acacia polyacantha*.
E: Set yoghurt with *Acacia seyal*.

Table 4: Effect of storage period on wheying off and synersis of set yoghurt

Item	Storage period (days)					
	0	4	8	12	16	20
Wheying off (ml)	0.00^{d}±0.00	0.45^{c}±0.11	0.50^{bc}±0.09	0.55^{b}±0.10	0.65^{b}±0.05	0.71^{a}±0.04
Synersis (%)	0.00^{e}±0.00	2.19^{d}±0.10	2.59^{c}±0.08	2.91^{b}±0.11	3.02^{ab}±0.09	3.40^{a}±0.08

*Means±SDin the same row having different superscript letters are significantly different (P≤0.05).

Table 5: Effect of type of Acacia gum on minerals content (mg/100g) of set yoghurt

Minerals content	Type of acacia gum					
	A	B	C	D	E	F
Calcium	141.73^{f}±0.23	192.30^{a}±0.19	180.47^{b}±0.25	174.19^{c}±0.24	165.73^{d}±0.21	154.68^{e}±0.20
Phosphorous	94.40^{e}±0.22	122.48^{a}±0.21	114.29^{b}±0.20	110.28^{c}±0.22	119.44^{ab}±0.23	103.32^{d}±0.25
Magnesium	129.74^{f}±0.20	194.73^{a}±0.15	177.44^{b}±0.13	175.29^{bc}±0.14	142.78^{e}±0.20	155.78^{d}±0.21

*Means± SD in the same row having different superscript letters are significantly different (P≤0.05)
A: Set yoghurt without Acacia gum (control)
B: Set yoghurt with Acacia senegal.
C: Set yoghurt with Acacia leata.
D: Set yoghurt with Acacia polyacantha.
E: Set yoghurt with Acacia seyal.
F: Set yoghurt with Acacia fistula.

Table 6: Effect of storage period on minerals content (mg/100g) of set yoghurt

Minerals	Storage period (days)					
	0	4	8	12	16	20
Calcium	164.38^{e}±0.18	164.33^{a}±0.19	164.27^{a}±0.20	164.20^{a}±0.15	164.00^{a}±0.18	163.25^{b}±0.16
Phosphorous	85.48^{c}±0.17	103.80^{a}±0.20	105.39^{a}±0.17	105.34^{a}±0.16	105.29^{a}±0.18	103.35^{b}±0.15
Magnesium	164.58^{a}±0.14	163.34^{b}±0.08	162.78^{c}±0.10	162.24^{c}±0.11	162.18^{c}±0.09	162.13^{c}±0.06

*Means± SDin the same row having different superscript letters are significantly different (P≤0.05).

Magnesium content: Table 5. shows the effect of type of Acacia gum on magnesium content of set yoghurt. The highest value (194.73 mg/100g) by sample (B), and the lowest (129.74 mg/100g), by sample (A), while the other samples ranked in an intermediate position (P≤0.05).Table 6. show the effect of storage period on magnesium content of set yoghurt. The highest value (167.78 mg/100g) was obtained at 8 days of the storage period, and the lowest (162.13 mg/100g) was obtained at the end (P≤0.05). Zehra and Hassan (2008) found that, the magnesium content decreased during storage period. Hidiroglou and Proulx (1982) reported that milk Mg content was high during the first day of storage, decreasing sharply at 2 and day and then dropping gradually when storage progressed.

Organoleptic properties

Appearance: The appearance of set yoghurt was significantly (P≤0.05) affected by types of acacia gum (Table7). The highest score (5.50) by sample (C) and the lowest (3.98) by sample (A), while the other samples ranked in an intermediate position (P≤0.05).
Table 8. show the effect of storage period on appearance of set yoghurt. The highest score (5.80) was obtained at the beginning of the storage period (P≤0.05), and the lowest (4.20) at the end. During storage period appearance score decreased progressively with the storage time (P≤0.05) due to increase in moister content. El-Gazzar and Hafez, (1992).; Celik and Bake, 2006). Generally the appearance property decreased progressively with storage time (Galal *et al.*, 2004). Apperance mean scores decreased prolonging the cold storage period (Mervat *et al.*, 2007). Ibrahim *et al.,* (1989) reported that the appearance recorded high score in the beginning of the storage period, this might be attributed to its high fat content.

Texture: Table 7. shows the effect of type of acacia gum on texture of set yoghurt. The best texture score (5.77) by sample (C), and the infier texture score (4.86) expressed by sample (A), while the other samples ranked at an intermediate position (P≤0.05).Table 8. show the effect of storage period on texture of set yoghurt. The best texture score (5.85) was obtained at the beginning of the storage period, while the loss texture expression score (4.88) was occurred at the end (P≤0.05).The texture was gained the highest score by sample (C) due to the high original viscosity of *Acacia leata*, texture score decreased progressively with the storage period (P≤0.05) due to increase in moisture content. El- Gazzar and Hafez, (1992).; Celik and Bake, (2006). Yoghurt prepared with stabilizer ranked higher score for texture and appearance compared to the control yoghurt. This trend of results was also recorded during storage (El-shibiny *et al*., 1979 and Mervat *et al.*, 2007).

Flavour: Table 7. shows the effect of type of acacia gum on flavour of set yoghurt. The highest score (5.97) by sample (C), and the lowest (5.00) by sample (A), while the other samples ranked in an intermediate position (P≤0.05). Table 8. show the effect of storage period on flavour of set yoghurt. The highest score (5.94) was obtained at 12 days of storage (P≤0.05) and the lowest (4.83) at the end (P≤0.05). During storage period, flavour score increased with the storage time. Barrantes *et al*. (1994) and Ibrahim *et al*. (1989) reported that after storage, deterioration occurred in the organoleptic properties, consistency and taste. The flavour score increased progressively in all treatments with the storage time due to development of flavour compound by hydrolysis of fatty acids. Berranet *et al.* (1994) stated that the flavour score of stored yoghurt were higher than the fresh youghurt due to the development of flavour with storage period. Mervat *et al.* (2007) stated that, the flavour mean scores decreased significantly prolonging storage period. The production of flavour components such as acetaldehyde could be arised from fat, protein or lactose (Tamime and Deeth, 1980), but the bulk comes from the microbial fermentation of lactose. On the other hand, the low flavour score of yoghurt might be attributed to the fact that, fat protects the protein from enzymatic proteolysis, thus reducing the production of flavour components.

Acceptability: Table 7. shows the effect of type of Acacia gum on acceptability of set yoghurt. The highest score (5.78) by sample (C), and the lowest (4.67) by sample (A), while the other samples ranked in an intermediate position (P≤0.05). Table 8. show the effect of storage period on acceptability of set yoghurt. The highest score (5.65) was provided at the beginning of the storage period (P≤ 0.05), while the lowest (5.00) at the end. The acceptability of yoghurt decreased gradually during storage as a result of deterioration of taste and consistency. El-Gazzar and Hafez (1992) and Mohammed (2008) concluded that during storage period, acceptability score decreased in all levels with storage times progressed due to deterioration consistency and tast.

Table 7. Effect of type of Acacia gum on acceptability of set yoghurt

Quality attributes	Type of Acacia gum					
	A	B	C	D	E	F
Appearance	3.98^{d}±0.03	5.45^{a}±0.02	5.50^{a}±0.05	5.28^{b}±0.12	4.98^{c}±0.04	4.93^{c}±0.06
Texture	4.86^{d}±0.02	5.73^{a}±0.17	5.77^{a}±0.07	5.57^{b}±0.10	5.50^{c}±0.06	5.46^{c}±0.07
Flavour	5.00^{c}±0.05	5.95^{a}±0.15	5.97^{a}±0.03	5.75^{a}±0.09	5.43^{a}±0.08	5.40^{b}±0.05
Overall acceptability	4.67^{b}±0.01	5.74^{a}±0.05	5.78^{a}±0.10	5.75^{a}±0.08	5.31^{c}±0.06	5.30^{c}±0.06

*Means± SD in the same row having different superscript letters are significantly different (P≤0.05)

A: set yoghurt without Acacia gum (control).
B: Set yoghurt with *Acacia senegal*.
C: Set yoghurt with *Acacia leata*.
D: Set yoghurt with *Acacia polyacantha*.
E: Set yoghurt with *Acacia seyal*.
F: Set yoghurt with *Acacia fistula*.

Table 8: Effect of storage period on sensory evaluation of set yoghurt

Quality attributes	Storage period (days)					
	0	4	8	12	16	20
Appearance	5.80^{a}±0.07	5.65^{ab}±0.08	5.00^{b}±0.08	4.79^{bc}±0.10	4.67^{c}±0.08	4.20^{c}±0.07
Texture	5.85^{a}±0.09	5.75^{b}±0.13	5.73^{bc}±0.10	5.70^{c}±0.07	4.98^{d}±0.06	4.88^{d}±0.11
Flavour	4.92^{c}±0.11	5.00^{b}±0.12	5.51^{ab}±0.03	5.94^{a}±0.15	5.00^{c}±0.10	4.83^{d}±0.03
Acceptability	5.65^{a}±0.06	5.60^{ab}±0.08	5.56^{b}±0.09	5.43^{c}±0.07	5.30^{cd}±0.08	5.00^{d}±0.06

*Means± SD in the same row having different superscript letters are significantly different (P≤0.05).

Conclusion

The type of *Acacia gum* significantly(P≤0.05) affected the quality of set yoghurt. Addition of *Acacia gums* decreased levels of titatable acidity, whey off and synersis. While increased pH values, total solid, protein, fat, calcium, phosphorous, magnes-ium and viscosity compared with the control. *Acacia leata gum* manifested the best yoghurts quality followed by *Acacia Senegal*, *Acacia polyacantha*, *Acacia Segal var Segal*, *Acacia segal var* fistula and finally the control.

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تأثير أنواع صمغ الاكاشيا وفترة التخزين علي خواص الجودة للزبادي الجامد

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المستخلص

تمت دراسة تأثير استخدام أنواع صمغ الاكاشيا المضافة بنسبة 0.3% وفترة التخزين علي جودة الزبادي المصنع من لبن الأبقار. انوع صمغ الاكاشيا احتوت علي صمغ الهشاب، الشباهي، الكاكموت، الطلح الابيض والطلح الاصفر كمادة مثبتة لقوام الزبادي. تم إضافة البادئ بنسبة 5% بعد بسترة اللبن علي درجة حرارة°85م لمدة 10 دقائق. تم تحضين اللبن علي درجة حرارة°45م لمدة أربع ساعات ثم بُرد إلي درجة حرارة°2±6م وخزن لمدة 20 يوماً. تم تقدير كل من الصفات الفيزيوكيميائية، الصفات الريولوجية، محتوى المعادن والقبول خلال فترة تخزين 0، 4، 8، 12، 16 و20 يوماً. أوضحت التحاليل الفيزوكيميائية أن كل العينات تناقصت في قيمة الأس الهيدروجيني الـ pH خلال فترة التخزين. القيمة الاعلى (4.18) تم الحصول عليها بواسطة عينة الزبادي المعاملة بصمغ الشباهي والأدنى (3.62) بواسطة الشاهد. إضافة صمغ الاكاشيا أدى الي انخفاض($p\leq0.05$) مستوي الحموضة المعايرة لكل عينات الزبادي مقارنة بالشاهد. سجلت عينة الزبادي المعاملة بصمغ الشباهي اعلى قيمة (19.25%) للمواد الصلبة، البروتين (4.22%)، والرماد (1.21%). محتوى الدهن الاعلى (3.41%) تم الحصول عليه بواسطة عينة الزبادي المعاملة بصمغ الهشاب اما اقل كمية (2.92%) سجلت بالعينة الشاهد. كان الشاهد هو الأقل (2116 cps) في اللزوجة بينما كانت العينة المعاملة بصمغ الهشاب هي الاعلى (2505cps). أوضحت التحاليل الريولوجية أن الشاهد اعطى اعلى معدل لانفصال الشرش وكمية الشرش (2.98%, 0.92ml) بينما الاقل (1.85%, 0.38ml) سجلت بواسطة صمغ الشباهي، كانت هناك زيادة بسيطة في انفصال الشرش وكمية الشرش في كل العينات بتقدم فترة التخزين. كل عينات الزبادي المعاملة بأنواع صمغ الاكاشيا تسببت في زيادة محتوى الفسفور حتى اليوم الثامن من فترة التخزين. القيمة الأعلى (48 .122ملجم/100جم) كانت للعينات المعاملة بصمغ الهشاب والقيمة الأقل (94.40 ملجم/100 جم) للشاهد. أدي صمغ الهشاب الي زيادة مماثله في الكالسيوم والمغنيسيوم، القيم الاعلى (192.30 و 194.73 ملجم/100جم بالترتيب) في حين أن الشاهد أعطـــــى القيمة الاقـــل(129.74 و 141.73 ملجم/100جم بالترتيب) علي العموم تناقصت محتوى المعادن المقدرة خلال فترة التخزين. أوضح التقييم الحسي ان العينة المعاملة بصمغ الشباهي أعطت أفضل القيم لصفات المظهر (5.50)، القوام (5.77)، النكهة (5.97) والقبول العام (5.78)، تليها العينات المعاملة بصمغ الهشاب (5.45, 5.73, 5.95, 5.75،) صمغ الكاكموت (5.75, 5.28, 5.57, 5.75)، وصمغ الطلح الأبيض (4.98, 5.50, 5.43, 5.31)، صمغ الطلح الأصفر (4.93، 5.46، 4.40 و 5.30) واخيراً الشاهد (3.98, 4.86, 5.00, 4.47). اثرت فترة التخزين علي جودة الزبادي لصفات المظهر، القوام والقبول العام. معاملات التقييم الحسي الثلاث أعطت افضل القيم في بداية فترة التخزين والأقل في النهاية. بالنسبة للنكهة فقد تطورت حتى اليوم الثاني عشر من بداية فترة التخزين بتسجيل اعلى القيم (5.12) وتناقصت إلي اقل مستوي (4.41) عند نهاية فترة التخزين