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Microbial Characteristics and Sensory attributes of Yoghurt Enriched with Arabic Gum (AG)

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Abstract

The main objective of this study was to evaluate the effect of Arabic Gum (AG) on physical characteristics of yoghurt. Cow's milk was collected from Khartoum University Farm in clean and sterilized ice containers, filtered, pasteurized at 85^{o}C for 30 sec and then cooled to 42^{o}C. Yoghurt samples were formulated with 0%, 0.1%, 0.3% and 0.5% Arabic Gum. Starter culture MIX505LYODCU (*Streptococcus thermophilus* and *Lactobacillus bulgaricus* SSP.). Danisco, France was added at the level of 3% then, samples were incubated at 42^{o}C for four hours. After setting, yoghurt samples were then kept refrigerated at 4^{o}C for 24hrs. Microbial properties and sensory attributes were determined using the standard analytical procedures. Statistically, Completely Randomized Design (CRD) in 2x2x3 factorial arrangement was used. The data collected were subjected to (ANOVA) using SAS software. The results revealed that, there were significant differences of TVBC ($P \leq 0.05$) among the different treatments. Sample formulated with 0.3% Arabic gum had TVBC of 7.11log$_{10}$cfu/g, while, untreated sample had TVBC of 5.26log$_{10}$cfu/g. TVBC of all the samples increased significantly ($P<0.05$) throughout the storage period. All samples formulated with Arabic gum were *E.coli* free. The results show that there were significant ($P<0.05$) difference in Lactic Acids Bacteria when the level of AG differed. LAB decreased as gum level increased.Concerning sensory attributes, the appearance score significantly ($P \leq 0.05$) affected by the gum concentration. Appearance score reduced as the gum level increased. Untreated sample had the highest flavor score 6.20. Texture score significantly ($P \leq 0.05$) affected by gum concentration increased. Generally, overall acceptbility of yoghurt reduced significantly ($P \leq 0.05$) during the storage period.

Key: Yoghurt, Arabic Gum (AG), TVBC, LAB, *E.coli* and sensory characteristics.

Introduction

Livestock is the main agricultural resource in Sudan. It's population is 105 million heads, distributed throughout the country according to the climatic conditions (MLFR, 2015). However, milk production from these animals was estimated as 4391.000 tons (MLFR, 2015). Milk is considered as a nearly complete food since it is a good source for protein, fat and major minerals (Sarkar, 2010). Fermented dairy product have been extensively consumed around the globe because of their nutritional importance and improved sensory attributes (Clark, 2017). Yogurt is fermented dairy product, it contains significant amount of proteins having high biological value, traces of mono- and disaccharides and appreciable quantities of minerals such as sodium, potassium, calcium and magnesium etc. Besides, it also possesses considerable quantities of several other health promoting substances such as vitamin A, biotin, thiamine, riboflavin, folic acid, nicotinic acid, pantothenic acid and ascorbic acid. Additionally, yogurt also has several therapeutic impacts such as enhancing the digestion and immune functionality and reducing the serum cholesterol level (Guinard *et al.,* 1997). Several methods have been applied to improve consistency and/or texture of yoghurt. The most commonly used methods include an increase of total solids in the milk and the addition of gums as stabilizers (Clark, 2017). The factors known to improve consistency are increasing total solids, manipulation of processing variables, and characteristics of starter culture, (Omer, 2003). One approach to improve the yoghurt quality uses of stabilizer such as gums (Hussein, 2006). Gum is a polysaccharide of hydrocolloids. Exudate gums are used in an overwhelming number of applications, mainly situated in the food area (Glicksman, 1983). The gums have two major properties gelling and thickening, all gums by definition have a thickening effect. This property is the basis for their use as bodying, stabling and emulsifying agents in many foods such as: yoghurt, chocolate, milk drink, pudding, cottage cheeses, cream cheese, cheese spread. It uses in pharmacy, clinical such as: chronic kidney treatment, cholesterol and reduce the cholesterol levels in blood and reduce plasma cholesterol (Glicksman, 1982).

Objectives:

1- Effect of Arabic Gum (AG) addition on microbial attributes of yoghurt throughout the storage period

2- Effect of Arabic Gum (AG) addition on sensory attributes of yoghurt throughout the storage period

2. MATERIALS AND METHODS

2.1 Materials

Fresh cow's milk sample were obtained from Khartoum university farm and transferred immediately in sterilized container in an ice box to the Animal Products Department laboratory, National Food Research Center (NFRC), Shambatt. Starter culture MIX505LYODCU, freeze-dried form, Danisco France was obtained from a domestic dairy factory at Khartoum State. Arabic Gum (AG) was purchased from Arabic Gum Company. Chemicals and reagents used were obtained from the Lab line company-Khartoum. All the chemical and reagents were of analytical grades.

2.2 Methods

2.2.1 Preparation method

2.2.1.1 Arabic Gum preparation

Gum Arabic, provided by Arabic Gum Company. Gum samples were dried at room temperature and cleaned by hand to remove foreign particles and adhering bark. The samples were then ground using a mortar and piston, sieved through sieve No. 4 and kept in glass containers.

2.2.1.2 Yoghurt manufacture

Fresh milk was filtered through a sterilized cloth sheet, then it was analyzed for moisture, total solids, protein, fat, lactose, ash, pH and acidity. Samples were pasteurized at 85˚C for 30 seconds and left to cool down to 42^{o}C. The different treatment was added. Starter culture Yo-MIX505LYODCU was added at the level of 3% (w/v) containing a mixture of (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*) at ratio of 1:1, then samples were incubated at 42^{o}C for about four hours. Samples were then kept refrigerated at 4^{o}C until needed.

2.2.2 Analytical method

2.2.2.1 Microbiological l analysis

The Microbiological analysis carried out according to Harrigan and McCance (1976).

2.2.2.2 Sensory evaluation

Sensory evaluation was determined according to the procedure of Cross *et al.* (1978).

2.2.2.3 Statistical analysis

The data collected from the different treatments were subjected to Completely Randomize Design (CRD) in 2×2×3 factorial arrangement using analysis of variance (ANOVA) and

Duncan's Multiple Range test was employed (Steel and Torrie, 1980). The SAS program (SAS, 2002), was used.

3-DESCUTION

3- Effect of Arabic Gum (AG) addition on microbial characteristics of yoghurt throughout the storage period

3.1 Total Viable Bacterial Count (TVBC)

Data in Table 1 shows the changes in Total Viable Bacterial Count (TVBC) of processed yoghurt as stabilized by different level of Arabic Gum (AG). Obviously, there were significant differences ($P \leq 0.05$) among the different treatments. Sample formulated with 0.3% Arabic gum had TVBC of 7.11$\log_{10}$cfu/g, while, untreated sample had TVBC of 5.26$\log_{10}$cfu/g. Similar results were reported by Abdelgadir (2018) who found that, samples formulated by 0.3% Gum Arabic was higher TVBC 3.55$\log_{10}$cfu/g, when compared to that sample formulated by 0.1% Arabic gum 2.88$\log_{10}$cfu/g. The TVBC of control sample in this study was far lower than that reported by Eissa (2008), who found that, TVBC of untreated yoghurt was 5.77$\log_{10}$cfu/g. Moreover; these gums are classified as a natural prebiotic which considered a good substance for the viability of probiotic bacteria. Similarly, the same trend of increase was noticed by Elhassan (2017).

TVBC of all the samples increased significantly ($P<0.05$) throughout the storage period. This could be attributed to, the growth of Lactic Acid Bactria (LAB). All results of TVBC at the end of storage period for all samples were found to be higher than those recorded at the beginning of storage period. This could be attributed to the increase of lactic acid bacteria during storage period. It may also be due to enhancement in acidity values of yoghurt with the passage of time. These results were in line with the findings of Malik *et al.,* (2012). Similar results were reported by Hamad *et al.,* (2016); Elhassan (2017). Generally, the results of TVBC obtained in this study for all stabilized samples were far less than the limit which specified by the Sudanese standard of set yoghurt (SSMO, SDS 5361/2013), which stated that TVBC of set yoghurt should be not more than10$\log_{10}$cfu/g..

Table 1: Effect of Arabic Gum (AG) addition on Total Viable Bacterial Count (TVBC) log_{10}cfu/g of yoghurt throughout the storage period

Treatment	Storage period (days)				Treatment mean
	0	4	8	12	
Control	4.62^{m} ±0.02	4.92^{l} ±0.02	5.62^{j} ±0.02	5.87^{i} ±0.02	5.26^{C}
0.1% (AG)	5.53^{k} ±0.05	5.88^{hi} ±0.02	5.79^{f} ±0.02	6.94^{d} ±0.01	6.29^{B}
0.3% (AG)	5.92^{h} ±0.01	6.61^{g} ±0.04	7.92^{b} ±0.02	7.98^{a} ±0.01	7.11^{A}
0.5% (AG)	4.87^{l} ±0.02	5.86^{i} ±0.01	7.70^{c} ±0.02	6.86^{e} ±0.01	6.32^{B}
Overall	5.24^{C}	5.81^{B}	7.01^{A}	6.91^{AB}	
$Lsd_{0.05}$	0.05259^{**}				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

**Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

3.3 *E.coli*

Table 2, revealed that, the effect of formulating yoghurt with the different levels of *E.coli*. Obviously, Arabic Gum had effect on the *E.coli* growth. All samples formulated with Arabic gum were *E.coli* free throughout storage period. Abdelgadir (2018) reported that, there was no detection of *E.coli* bacteria among yoghurt samples formulated with Arabic Gum. The present results accordance with that mentioned by Abdalla and El Zubeir (2006) who stated that coliform bacteria should not be present in fermented dairy products prepared from adequately pasteurized milk, as their presence suggests inadequate pasteurization or recontamination after heating.

Table 2: Effect of Arabic Gum (AG) addition on *E.coli* of yoghurt throughout the storage period

Treatment	Storage period (days)				Overall
	0	4	8	12	
Control	6.33^{a}	4.67^{b}	3.33^{c}	5.67^{a}	5.00^{A}

	±0.04	±0.02	±0.03	±0.03	
0.1 (AG%)	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{B}
0.3 (AG%)	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{B}
0.5 (AG%)	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{d} ±0.00	0.00^{B}
Overall	1.58^{A}	1.17^{B}	0.83^{C}	1.42^{AB}	
$Lsd_{0.05}$	0.8658^{**}				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

3. Lactic Acid Bacteria (LAB)

The results given in Table 3, shows the mean of LAB of yoghurt (produced with different concentration of Arabic gum (AG). The results show that there were significant (P<0.05) difference in Lactic Acids Bacteria when the level of AG differed. Obviously, LAB decreased as gum level increased. The control sample reported the lowest LAB 5.20 $\log_{10}$cfu/g. Samples stabilized with 0.1% and 0.3% AG were LAB of 6.10 and 6.80$\log_{10}$cfu/g, respectively. Similar result was found by Abdelgadir (2018) who found that, LAB increased as gum level increased. This is most likely due to the increase in Gum Arabic concentration which partly leads an increase in the acidity due to its acidic nature. Gum Arabic consists mainly of salts of acidic arabinogalactans protein complex which yields glucose, arabinose rhamnose and glucuronic acid (Karamalla, 1999, Elhassan, 2017). It worth mentioning that, LAB reduced to 7.27$\log_{10}$cfu/g when sample stabilized with 0.5% AG. This could be attributed to, the growth of yeast and moulds.

Lactic Acids Bacteria (LAB) as affected by the storage period. LAB of all the samples increased significantly (P≤0.05) during the storage period of twelve days. Prominently, clear

increase in LAB was observed at the 5th day log_{10}cfu/g 7.53 of storage period for all processed yoghurt followed by decrease till the end of storage period (12th day) 8.05 log_{10}cfu/g, which indicates certain instability of the starter cultures during shelf life. Simultaneously, a gradual drop in pH of yoghurt was observed as a result of acidity development causes by covert of lactose sugar to lactic acid at the same period of storage as stated by Lee and Lucey (2010).

Table 4: Effect of Arabic Gum (AG) addition on Lactic Acids Bacteria (LAB) of yoghurt throughout the storage period

Treatment	Storage period (days)				Overall
	0	4	8	12	
Control	5.80^{l} ±0.04	6.54^{j} ±0.04	6.83^{h} ±0.02	6.90^{g} ±0.03	6.52^{C}
0.1 (AG%)	5.93^{k} ±0.01	6.90^{g} ±0.03	7.68^{f} ±0.03	7.87^{d} ±0.01	7.10^{BC}
0.3 (AG%)	6.62^{i} ±0.02	7.76^{e} ±0.02	7.93^{c} ±0.02	8.87^{a} ±0.04	7.80^{A}
0.5 (AG%)	5.90^{k} ±0.02	6.92^{g} ±0.02	7.69^{f} ±0.05	8.57^{b} ±0.08	7.27^{B}
Overall	6.07^{D}	7.03^{C}	7.53^{B}	8.05^{A}	
$Lsd_{0.05}$	0.05259^{**}				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

3.4. Effect of Arabic Gum (AG) addition on sensory characteristics of yoghurt through storage period

3.4.1 Appearance

Sensory evaluation is defined as the science of judging and evaluating the quality of a food by the use of the senses, i.e. taste, smell, sight, touch and hearing. Yoghurts quality was determined by the process of hedonic scaling. Table 4, shows that, the appearance score significantly (P≤0.05) affected by the gum concentration. Appearance score reduced as the gum level increased. The panelists gave control sample the highest appearance score 5.35, and gave the lowest score 3.67, for the sample treated with 0.5% Arabic gum. Similar results were found by

Abdelgadir (2018) who noticed that, appearance score was significantly decreased as gum concentration increased. This means that the increment in the concentration of gums used in this study had negative influence on the color where the panelists mostly preferred white color in set yoghurt. Abdalla (2009) reported that gum is usually coloured, and the colours are usually referred to as impurities which in turn affect its quality.

Evidently, among all yoghurt samples a significant ($P \leq 0.05$) deterioration in appearance scores were observed by the passage of storage time. At initial time samples had appearance score of 4, at day 4, 5 and 12 had appearance score of 4.97, 4.59 and 4.01, respectively. According to Aly *et al.*, (2004), during storage period the hydrolysis by microorganisms on fat content gave smooth homogenous bright yellow color. Similar observed were noticed by Abdelgadir (2018); Hamad *et al.*, (2016) and Niamah (2016).

Table 4: Effect of Arabic Gum (AG) and storage period on Appearance score of yoghurt

Treatment	Storage period (days)				Treatment mean
	0	4	8	12	
Control	6.00^{a} (±0.00)	5.90^{b} (±0.00)	4.88^{c} (±0.00)	4.64^{d} (±0.00)	5.35^{A}
0.1% (AG)	5.78^{b} (±0.00)	5.40^{c} (±0.00)	5.48^{d} (±0.00)	4.34^{e} (±0.00)	5.25^{B}
0.3% (AG)	5.30^{c} (±0.00)	4.80^{d} (±0.00)	4.36^{e} (±0.00)	3.80^{f} (±0.00)	4.25^{C}
0.5% (AG)	4.00^{d} (±0.00)	3.80^{e} (±0.00)	3.64^{f} (±0.00)	3.26^{g} (±0.00)	3.67^{D}
Overall	5.27^{A}	4.97^{B}	4.59^{C}	4.01^{D}	
$Lsd_{0.05}$	0.0002795				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different ($P \geq 0.05$).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different ($P \leq 0.05$).

3.4.2 Taste

Table 5, demonstrated the taste score of yoghurt significantly ($P \leq 0.05$) affected by the gum concentration. Also, taste score significantly ($P \leq 0.05$) affected with storage period. Clearly, as

gum concentration of yoghurt increased taste score decreased. The highest score was recorded for the untreated sample 5.87, while the lowest score 5.04, was recorded for samples formulated with 0.5% gum Arabic. Abdelgadir (2018) found that, yoghurt sample stabilized by 0.1% and 0.3% Arabic gum had taste score of 7.22 and 7.06, respectively. Similar results were found by Hamad *et al.,* (2013) who found that, the addition of Arabic gum to Rob (fermented milk) reduced the taste score of the developed product. Elhassan (2017) reported that, taste score of ice cream recued when stabilized with Arabic gum. Palich (1994) found that, the addition of gum to ice cream reduced taste score.

However significant (P≤0.5) reduction in taste score was noticed during storage period. Taste score ret redo gradation throughout the six month of the experiment at initial time yoghurt samples was taste score with a mean of 5.33, at storage two recorded taste score of 5.29, these reduction continues to reach 5.00 at the month six of store. These could be cause by the growth of bacteria during storage period as reported by Singh *et al*., (2014). Another explains, the deterioration of taste scores during storage period could be due to increase in moisture and acidity content. Matching results, Barrantes *et al.,* (1994) and Ibrahim *et al.,* (1989) reported that after storage, deterioration occurred in the organoleptic properties, consistency and taste.

Table 5: Effect of Arabic Gum (AG) addition on Taste score of yoghurt throughout the storage period

Taste	Storage (days)				
Treatment	0	4	8	12	Treatment Means
Control	6.473^{f} (±0.11)	6.400^{f} (±0.41)	5.353^{fg} (±0.01)	5.306^{fgh} (±0.03)	5.87^{A}
0.1% (AG)	5.736^{e} (±0.41)	5.720^{a} (±0.79)	5.306^{a} (±0.46)	5.240^{a} (±0.78)	5.50^{B}
0.3% (AG)	5.180^{bcd} (±0.76)	5.173^{ghij} (±0.89)	5.080^{cd} (±0.90)	5.046^{cd} (±0.98)	5.12^{D}
0.5% (AG)	5.093^{hij} (±0.20)	5.083^{ij} (±0.61)	5.020^{j} (±0.61)	5.000^{j} (±0.98)	5.04^{F}
Overall	5.337^{A}	5.292^{B}	5.094^{C}	5.000^{D}	
Lsd0.05	0.000287				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

3.4.3 Flavor

The results of flavor acceptability of the stabilized yoghurt samples analyzed are presented in Table 6. From the results, there were significant differences (P≤0.05) among all stabilized samples. Untreated sample had the highest flavor score 6.20, samples stabilized with 0.1%, 0.3 and 0.5% Arabic Gum reported flavor scores of 5.49, 5.07 and 5.06, respectively. Similar results were found by Abdelgadir (2018) who reported that, yoghurt samples stabilized with 0.1% and 0.3% Arabic gum had flavor score of 7.46, 7.33, respectively. That mean, flavor scores reduced as gum concentration increased. Hamad *et al.,* (2016) who found that, flavor score of fermented milk (Rob) significantly reduced when formulated with Arabic Gum. In contrast, Barranet *et al.,* (1994) found that, the flavor score of yoghurt formulated with gum was higher than that fresh yoghurt. Abdelgadir (2018) stated that, the presence of a little amount of tannins may have strong effect on yoghurt flavor by the interaction with flavor compounds produced by microorganisms of yoghurt.

Statistical data revealed that the flavor score reduced significantly (P≤0.05) gradually during the storage period Table 14. However, the mean of flavor scores at initial time was 5.67, while, the flavor mean at the end of storage period was 5.16. These results were in agreement with the findings of Abdel Razig *et al.,* (2015); Elhassan (2017) and Abdelgadir (2018). The gradual increase of flavor score with the storage time might be due to development of flavor compounds by hydrolysis of fatty acids. The production of flavor components such as acetaldehyde could be raised from fat, protein or lactose Tamime and Robinson (1980), but the bulk comes from the microbial fermentation of lactose. On the other hand, the low flavor score of yoghurt might be attributed to the fact that, fat protects the protein from enzymatic proteolysis, thus reducing the production of flavor components. In addition, Reineccius (2006) mentioned that, odor (Flavor) is the complex sensation occurring because of the interaction of the volatile food components with the olfactory receptors, whose stimulus can be orthonasal

(entrance of the odor stimulus is directly from the nose when one sniffs the food) or retro nasal (entrance of the stimulus from the oral cavity when someone eats a food).

Table 6: Effect of Arabic Gum (AG) addition on Flavor score of yoghurt throughout the storage period

Flavor	Storage (days)				
Treatment	0	4	8	12	Treatment means
Control	6.533^{fghij} (±0.22)	6.473^{fghij} (±0.11)	6.460^{ghij} (±0.10)	5.343^{hikl} (±0.06)	6.202^{A}
0.1% (AG)	5.853^{deg} (±0.13)	5.433^{a} (±0.20)	5.366^{ab} (±0.54)	5.333^{abc} (±0.67)	5.496^{B}
0.3% (AG)	5.190^{jkl} (±0.86)	5.103^{defg} (±0.45)	5.008^{efgh} (±0.98)	5.002^{efghi} (±0.40)	5.076^{C}
0.5% (AG)	5.136^{lm} (±0.10)	5.100^{ijkl} (±0.40)	5.003^{jkl} (±0.98)	5.000^{jkl} (±0.70)	5.060^{D}
Overall	5.678^{A}	5.527^{B}	5.272^{C}	5.169^{D}	
Lsd0.05	0.000269				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

3.4.4 Texture

Table 7, shows that, the texture score significantly (P≤0.05) affected by the gum level. The lowest texture score was reported for untreated sample 5.16, whereas, the highest texture score was reported for the sample treated with 0.5% gum Arabic 6.34. However, as gum level increased texture score increased. Obviously, AG addition enhanced the texture score. This might be attributed to the results of lower viscosity and higher syneresis which were achieved by control sample. The same observation was reported by Abdel Razig *et al.,* (2015). Hamad *et al.,* (2016) found that, texture score of Rob was enhanced when gum level increased.

Generally, appearance, taste, flavor and texture score was trend to reduced gradually thorough storage period. Similar observations were reported by Elhassan (2017) who stated that there was deteriorated in texture scores of ice cream during storage period. Celik and Bake (2006) stated that texture score decreased progressively with the storage period (P≤0.05) due to increase in moisture content.

Table 7: Effect of Arabic Gum (AG) addition on Texture score of yoghurt throughout the storage period

Texture	Storage period (days)				
Treatment	0	4	8	12	Treatment means
Control	6.466^{kl} (±0.10)	6.463^{l} (±0.30)	6.373^{l} (±0.26)	5.353^{l} (±0.97)	5.164^{G}
0.1% (AG)	6.633^{j} (±0.46)	6.360^{bcde} (±0.68)	6.250^{cdef} (±0.98)	5.236^{defg} (±0.90)	6.120^{D}
0.3% (AG)	6.826^{h} (±0.40)	6.573^{a} (±0.56)	6.373^{bcde} (±0.60)	5.330^{bcde} (±0.90)	6.275^{B}
0.5% (AG)	6.946^{h} (±0.87)	6.576^{a} (±0.86)	6.476^{ab} (±0.60)	5.390^{bcd} (±0.97)	6.347^{A}
Overall	6.767^{A}	6.363^{B}	6.34^{C}	5.317^{D}	
Lsd0.05	0.000230				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

4.4.5 Overall acceptability

Table 7 revealed the effect of adding Arabic gums as stabilizer on the overall acceptability of processed yoghurt during the storage period. Significant (P≤0.05) differences among the different treatments were observed. Increases Arabic gum concentration decreased the overall acceptability of yoghurt. The panelists preferred control sample when and gave overall acceptability of 5.87, whereas, sample stabilized with 0.5% had overall acceptability of 5.35.

Similar result was found by Abdelgadir (2018) who reported that, yoghurt samples stabilized with 0.1% and 0.3% Arabic gum had overall acceptability scores of 7.66, 7.13, respectively. The present results were in agreement with that reported by Hamad *et al.*, (2016) who reported that, the formulated fermented milk (Rob) by gum Arabic reduced the overall acceptability. In contrary, Elhassan (2017) found that, the formulated ice cream by gum enhanced the overall acceptability of the product.

In terms of the effect of storage time on overall acceptability, it was evident that there was gradual decrease in overall acceptability scores of yoghurt. A slight degradation in overall acceptability was noticed. These results were in accordance with those obtained by Abdel Razig *et al.*, (2015). The decrease in overall acceptability scores of yoghurt during storage period explained by the deterioration of taste and consistency as stated by Mohammed (2008), who concluded that during storage period acceptability scores decreased as storage time progressed due to deterioration of consistency and taste.. According to Lee and Lucey (2010) the physical attributes of yoghurts, including the lack of visual whey separation, are crucial aspects of the quality and overall sensory consumer acceptance.

Table 8: Effect of Arabic Gum (AG) addition on overall acceptability score of yoghurt throughout the storage period

Overall acceptability	Storage (day)				
Treatments	0	4	8	12	Treatment means
Control	6.376^{i} (±0.21)	5.786^{f} (±0.20)	5.686^{g} (±0.10)	5.643^{gh} (±0.40)	5.87^{A}
0.1% (AG)	5.893^{e} (±0.24)	5.686^{a} (±0.70)	5.620^{a} (±0.89)	5.600^{a} (±0.30)	5.70^{B}
0.3% (AG)	5.556^{h} (±0.20)	5.446^{b} (±0.10)	5.426^{b} (±0.20)	5.406^{b} (±0.79)	5.45^{C}
0.5% (AG)	5.873^{n} (±0.90)	5.236^{k} (±0.98)	5.200^{k} (±0.97)	5.100^{l} (±0.80)	5.35^{D}
Overall	5.922^{A}	5.557^{B}	5.483^{C}	5.437^{D}	
Lsd0.05	0.000290				

Values are means ± SD.

*Means in the same column for the same parameter bearing the same superscript small letters are not significantly different (P≥0.05).

* *Means in the same row for the same parameter bearing different superscript capital letters are significantly different (P≤0.05).

Conclusion and Recommendation

Conclusion

- TVBC significantly (P≤0.05) influenced by gum concentration
- All samples formulated with Arabic gum were *E.coli* free.
- LAB significantly (P≤0.05) affected by gum concentration
- TVBC and LAB were significantly (P≤0.05) increased during storage period
    - In general addition Arabic gum improves the sensory properties of yoghurt

Recommendation

1. ***** Yoghurt with Arabic gum could be recommended for maintain the quality and enhanced the sensory properties.

REFERENCES

Abdelgadir., M, O. (2018). Characterization of three natural gums and their effect on stability of set yoghurt. Ph.D, Thesis, Faculty of Agriculture, University of Khartoum, Sudan.

Abdalla., E., A. (2009). Decolourization of Talha gum.M.Sc. Thesis, University of Khartoum, Sudan.

Abdalla., W., M. and El Zubeir., I., E., M. (2006). Microbial hazards associated with fermented milk (Roub and Mish) processing in Sudan International Journal of Dairy Sciences, 1: 21- 26.

Abdel Razig, K.A. Bashir, A.M. Kunna, M.M. Galad. A.M. (2015). Quality properties of set yoghurt as affected by types of Acacia gum and storage period. Sudan University of Science and Technology SUST, Journal of Agricultural and Veterinary Sciences (SJAVS), 16 (2): 8-19.

Ali., A., A, Ali., K..E, Fadlalla., A. and Khalid., K.,E. (2008). The effects of G.A. oral treatment on the metabolic profile of chronic renal failure patients under regular *haemodialysis* in Central Sudan.Natural Product Research. 22: 12-21.

Badreldin, H.A.; Z. Amal and B. Gerald (2008). Biological effects of gum Arabic: A review of some recent research. Food Chem Toxicol.47: 1-8.

Barrantes., E, Tammime., A.,Y. and Sword., A., M. (1994). Production of low-calorie yoghurt using skim milk powder and substitute.4-Rheological properties. Milchwissenschaft, 49:263-266.

Celik., S. and Bake., I. (2006). Physicochemical and organoleptic properties of yoghurt with cornelian cherry paste. International J. Food Properties, (9):401-408.

Clark, S.; Garcıa, M.(2017). . A 100-year review: Advances in goat milk research. J. Dairy Sci. 100: 10026–1004

Glicksman, M. (1982). Food Hydrocolloids, Vol. 1; CRC Press: Boca Raton, FL.

Glicksman, M. (1983). Food Hydrocolloids, Vol. 2; CRC Press: Boca Raton, FL.

Codex Standard (2003). Codex Standard for Fermented Milks, 243.

Cross, H.R.; Moen, R. and Stanifield, M.S. (1978). Guidelines for Training and Testing Judges for Sensory Analysis of Meat Quality. Journal of Food Technology. Vol. 32: 48-54.

Dickinson, E. and Stainsby, G. (1988). Advances in Food Emulsion and Foams. Emulsion stability Elsevier. Applied Science: (pp.1- 44).

DF (2003). Dairy Facts. Edition. Nutrition Information, 13. International Dairy Foods. Association. Washington, DC.12.

Eissa., E., A. (2008). Chemical and microbial evaluation of homemade fermented yogurt (Zabadi) made from different milk sources. M.Sc, Thesis. Faculty of Agricultural, University of Khartoum.

Elhassan., E. H. (2017). Effect of different concentrations of some local gums on the quality of ice cream. Ph.D. Thesis. Faculty of Agriculture. University of Khartoum, Sudan.

Guinard., J., X, Little., C, Marty., C. and Palchak., T., R. (1994). Effect of sugar and acid on the acceptability of frozen yogurt to a student population. Journal of Dairy Science, 77: 1232-1238.

Guler, Z.; Park, Y.W. (2011). Characteristics of physico-chemical properties, volatile compounds and free fatty acid profiles of commercial set-type Turkish yoghurts. Open J. Anim. Sci., 1: 1-9

Harrigan, and McCance, M. E. (1976). Laboratory Methods in Microbiology. PP.27-3003, Academic Press, London and New York

Hamad., E., H, Sulieman., A., Salih., A., Z. (2016). Quality Aspects of the Sudanese Fermented Milk (Robe) Supplemented with Gum Arabic powder. Discourse Journal of agricultural and food science and technology. 1:7-8

Hussein., M., S. (2006). Comparative study on some Sudanese gums: Hashab (*Acacia Senegal*), talha (*Acacia seyal*) and karaya (*Sterculia setigera*). M.Sc. Thesis, Faculty of Science, University of Kordofan. Sudan.

Ibrahim., M., E., El- Batawy., M., A. and Elein., S., G. (1989). Evaluation of yoghurt on the market. Egyptian J. Dairy Sci., (17): 125- 136.

Ismaeil., A., E. (2018). Development and evaluation of quality attributes of air and freeze dried cow and goat yoghurt. PH.D, Thesis. Faculty of Agriculture, University of Khartoum. Sudan.

Karamalla., K., A. (1999). Gums stabilizers for food industry. Food Hydrocolloids, 10, 40.

Lee., W., J, and Lucey., J. A. (2010). Structure and physical properties of yoghurt gels: Effect of inoculation rate and incubation temperature. Australian Journal of animal science. Volume 23: 1127-1136.

Malik., A., H, Anjum., F., M, Sameen., A, Khan., M., I. and Sohaib., M. (2012). Extraction of starch from water chestnut (TrapabispinosaRoxb) and its application in yoghurt as a stabilizer. Pak. J. Food Sci., (22):209-218.

MLFR (2020). Ministry of livestock, Fishenes and Rangelands, department of Statistic and Information, Khartoum - Sudan.

Mohammed., A., N. (2014). Quality attributes of raw milk from different sources. M.Sc, Thesis, Faculty of Animal Production, University of Sudan. Sudan.

Omer., B., I. (2012). Characterization and simple fractionation of Acacia Senegal. Department of Chemistry, Faculty of science, Taif University, 888 Taif, Kingdom of Saudi Arabia.

Niamah., A. K., Gddoa., A.S.T and Jabbar., A. A. (2016). Gum Arabic uses as prebiotic in yoghurt production and study effects on physical, chemical properties and survivability of probiotic bacteria during cold storage. World Applied Sciences Journal, 34 (9): 1190-1196.

Palich., P. (1994). Study of changes in quality of ice cream during storage.Chlodnictwo, 29: 21–5 (Food Science and Technology.

Reineccius., G. (2006). An overview of flavor perception. Flavor chemistry and technology, 2nd ed. Boca Raton. Taylor and Francis. USA.

Ritzoulis., C. and Rhoades., J. (2013). Introduction to the Physical chemistry of foods. Boca Raton. Taylor and Francis, pp.159-171.

Sarkar., S. (2010). Approaches for enhancing the viability of probiotics: A review. British Food Journal, 112 (4), 329-349.

SAS. (2002). SAS User Guide, Release 6- 03. Edition SAS. Institute Inc. Gray, NC, USA.

Singh., J, Bajwa., U. and Goraya., R., K. (2014). Effect of storage period on the physicochemical, sensory and microbiological quality of bakery flavoured ice cream . International Journal of Engineering Research and Applications, 4(5): 80-90.

SSMO. (2013). Sudanese Standards and Metrology Organization, Sudanese Standard of Set Yoghurt (SDS, 5361). Cabinet of Ministers, Sudan Government.

Steel, R.G. and Torrie, J.H. (1980). Principles and procedures of statistics, MC Grow Hill, New York, USA.

Tamime., A., Y. and Robinson., R., K. (2007). Yoghurt - Science and Technology 3rd edition. Cambridge: Woodhead Publishing.