

## MICROBIOLOGICAL AND SENSORY PROPERTIES OF LOW FAT ICE CREAM FROM CAMEL MILK USING NATURAL ADDITIVES

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### Abstract

The present study was conducted on ice cream from camel milk using natural ingredient (honey, sugar, skim milk powder and gum Arabic). The ice cream mix was flavored with vanilla, coconut and a mixture of vanilla and coconut. Then, the ice cream was packed into plastic cups and stored in a freezer at  $-18^{\circ}\text{C}$  for eight weeks. The microbiological and sensory evaluations were carried out every week. The microbial count of flavored ice cream showed significant differences in total bacterial count and non significant differences in yeast and molds counts and psychrotrophic bacterial count. The coliform showed no growth in all ice cream samples during storage. The sensory evaluation revealed significant differences between ice cream samples for the average score of all sensory measurements. The high score for appearance was obtained in coconut ice cream samples. Also the overall acceptability of ice cream samples made from the mixture of vanilla and coconut revealed higher score compared to coconut ice cream samples and vanilla ice cream samples. It is concluded that some microbial counts were affected by the different added flavors to the ice cream. Combination of vanilla and coconut in ice cream showed more acceptability for the taste of camel milk ice cream

**Keywords:** camel milk, ice cream, honey, gum arabic, vanilla, coconut microbiological examination, sensory evaluation

Submitted: 13.04.2015

Reviewed: 02.06.2015

Accepted: 18.06.2015

## 1. INTRODUCTION

The trend towards natural products with emphasis on quality has in general led to an increase in the development of new products. Ice cream can be considered as an aerated suspension of crystallized fat and water in a highly concentrated sugar solution containing hydrocolloids, casein micelles, and proteins (Koxholt et al. 2001; Eisner et al. 2005). Ice cream is a frozen food made from a mixture of dairy ingredients, flavorings and sweeteners (Elhai et al., 2002; Marshall et al., 2003). Ice cream is a delicious and nutritious frozen dairy dessert with high calorie food value (Şengül et al. 2005; Khillari et al., 2007; Temiz and Yeşilsu, 2010). The texture of the ice cream depends on many factors such as the state of aggregation of the fat globules, the amount of air, the size of the air cells, the viscosity of the aqueous phase, and the size and state of aggregation of ice crystals (Bolliger et al. 2000; Aime et al. 2001; Caillet et al. 2003; Granger et al. 2005).

There are some flavors used in ice cream like vanilla (Aime *et al.* 2001; Gantait *et al.*, 2011), coconut (CheMan and Marina, 2006) and other additives in ice cream including honey (Khaliduzzaman *et al.*, 2012), which may serve as a natural food preservative due to its antimicrobial properties (Bradbear *et al.*, 2004; Al-Jabri, 2005).

The shelf life of ice cream is mainly dependent on the storage conditions, ice cream can last as long as one year or as little as two weeks. In order to maintain shelf life, some factors must be taken into consideration, including, proper formulation of the ice cream, such as the addition of stabilizer and sugar, freezing the ice cream quickly, hardening the ice cream rapidly and avoiding temperature fluctuations during storage and distribution (Marshall et al., 2003; Lee et al., 2005).

The dairy products from camel are still not well developed enough to reach a commercial scale (Al Haj and Al Kanhal, 2010) because there is

a need to examine consumer acceptability of these products (El Zubeir et al., 2012). Moreover when testing the overrun of camel milk ice cream it was found to significantly depend on the fat and MSNF levels in the mixture (Abu-Lehia et al., 1989). The objectives of this study are to study some of the microbial counts, shelf life and sensory properties of ice cream made from camel milk flavored with vanilla and coconut using natural additives (honey and gum Arabic).

## 2. MATERIAL AND METHODS

### 2.1 Sources of materials

The experimental procedures were done in the specialized small processing unit that located at Khartoum North during the period from June 2012 to August 2012. Fresh raw whole camel milk (15 liters) was obtained from camel milk from local farm at Khartoum North. The honey and flavors were obtained from Jeddah, Saudi Arabia, while gum Arabic, sugar and skim milk powder were obtained from local market of Khartoum North, Sudan.

### 2.2 Manufacturing of ice cream

Ice cream samples were made from camel milk with three flavors (vanilla, coconut and a mixture of vanilla and coconut) by the same percentage of gum Arabic, honey, sugar and low fat cream powder (0.7%, 9%, 6% and 11% respectively), for 15 liter of pure camel milk. First the milk was pasteurized at 72° C for 15 second, then honey, sugar, gum Arabic and skim milk powder were added, homogenized and then mixed. After cooling the mix in the refrigerator for 5° C, it was divided in to 3 portions and the selected flavors were added. The packaging was done in plastic cups; size 80 grams; and then stored at -18° C in a freezer.

### 2.3 Microbiological examination of ice cream

Sterilization of equipment such as flasks, test tubes, pipettes and Petri dishes were sterilized by hot air oven at 160° C for 60 minutes. The media were prepared by autoclaving at 121° C for 15 minutes. The media were then

allowed to cool at 45-46° C before pouring into Petri dishes (Singleton, 1992).

Preparation of samples was done as described by Marshall (1992). A representative samples of ice cream (1 gram) was mixed (1:10) with sterile distilled water and then diluted serially ( $10^{-1}$ -  $10^{-6}$ ). One ml from each of the selected dilution after thorough mixing was carefully transferred into the Petri dishes using sterile pipettes.

The plate count agar was used for enumeration of total bacterial count (Houghtby et al., 1992). Enumeration of coliform bacteria was done on Macconkey agar (Christen et al., 1992) and the method described by Frank et al. (1992) was used for enumeration of psychotrophic bacterial count on plate count agar. The plates for total bacterial count, coliform and psychotrophic bacteria were incubated at 37° C for 48 hours, 37° C for 48 hours and 7 ±1 °C for 10 day, respectively.

### 2.4 Sensory evaluation

Ten untrained panelists; however they were familiar with dairy products; were asked to judge on the quality of ice cream in terms of appearance, flavor, texture, taste and overall acceptability. The judge was based on the 5-Scales Hedonic Rating Test that provided in sensory evaluation sheet (excellent= 5, very good = 4, good = 3, fair = 2 and poor = 1).

### 2.5 Statistical analysis

The data were analyzed using Statistic version 8 (2003). Analysis of variance was run according to the following statistical model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

$Y_{ij}$  = the observation

$\mu$  = overall mean

$T_i$  = the fixed effect of treat (1,2,3)

$e_{ij}$  = random error term

The significant differences between means were separated by LSD and determined at  $P \leq 0.05$ .

### 3. RESULTS AND DISCUSSION

#### 3.1 The microbial count of ice cream from camel milk

The means of total bacterial count was significantly ( $P < 0.05$ ) lower in camel milk ice cream flavored with a mixture of vanilla and coconut. However yeast and mold counts revealed significantly ( $P < 0.05$ ) lower value for coconut ice creams samples (Table 1). Psychrotrophic bacterial count of different flavored camel milk ice cream samples showed non-significant ( $P > 0.05$ ) variation, while the coliform showed no growth (Table 1)

#### 3.1.1 Total bacterial count

Result in Table 2 showed the means for total bacterial count of camel milk ice cream during the storage. There were no significant ( $P > 0.05$ ) differences during the third, fourth, sixth and eighth weeks of storage between the different ice cream samples. However significant ( $P < 0.05$ ) differences were found during the first, second, fifth and seventh week of storage. The highest value of total bacterial count was obtained for coconut ice cream during first week ( $\log 4.71 \pm 0.05$ ) of storage, while the lowest value was obtained in coconut ice cream during the fifth week ( $\log 4.00 \pm 0.05$ ) of storage.

**Table 1: The microbial counts of vanilla and coconut ice cream made from camel milk during storage Mean**

Measurements		Vanilla ice cream	Coconut ice cream	Vanilla and Coconut ice cream
Total bacterial count	Means $\pm$ sd.	4.47 $\pm$ 0.06 <sup>a</sup>	4.47 $\pm$ 0.06 <sup>a</sup>	4.39 $\pm$ 0.06 <sup>b</sup>
	Maximum	4.59	4.71	4.63
	Minimum	4.31	4	4.04
Yeast and molds count	Means $\pm$ sd.	4.25 $\pm$ 0.07 <sup>a</sup>	4.14 $\pm$ 0.07 <sup>b</sup>	4.20 $\pm$ 0.07 <sup>a</sup>
	Maximum	4.57	4.57	4.61
	Minimum	3.24	3.15	3.30
Psychrotrophic count	Means $\pm$ sd.	4.42 $\pm$ 0.05 <sup>a</sup>	4.40 $\pm$ 0.05 <sup>a</sup>	4.41 $\pm$ 0.05 <sup>a</sup>
	Maximum	4.6	4.7	4.62
	Minimum	4.23	3.77	4.02
Coliform count	Means $\pm$ sd.	0	0	0
	Maximum	0	0	0
	Minimum	0	0	0

bearing the same superscripts letters are not significantly different ( $P > 0.05$ ).

**Table 2: Variations of total bacterial counts of vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla (cfu/g)	Coconut (cfu/g)	Vanilla and Coconut (cfu/g)
Week 1	4.312 $\pm$ 0.052 <sup>b</sup>	4.708 $\pm$ 0.052 <sup>a</sup>	4.145 $\pm$ 0.052 <sup>b</sup>
Week 2	4.402 $\pm$ 0.063 <sup>b</sup>	4.671 $\pm$ 0.063 <sup>a</sup>	4.039 $\pm$ 0.063 <sup>c</sup>
Week 3	4.523 $\pm$ 0.052 <sup>a</sup>	4.446 $\pm$ 0.052 <sup>a</sup>	4.537 $\pm$ 0.052 <sup>a</sup>
Week 4	4.588 $\pm$ 0.094 <sup>a</sup>	4.628 $\pm$ 0.094 <sup>a</sup>	4.585 $\pm$ 0.094 <sup>a</sup>
Week 5	4.318 $\pm$ 0.052 <sup>a</sup>	4.000 $\pm$ 0.052 <sup>b</sup>	4.243 $\pm$ 0.052 <sup>a</sup>
Week 6	4.540 $\pm$ 0.125 <sup>a</sup>	4.467 $\pm$ 0.125 <sup>a</sup>	4.443 $\pm$ 0.125 <sup>a</sup>
Week 7	4.573 $\pm$ 0.030 <sup>a</sup>	4.469 $\pm$ 0.030 <sup>b</sup>	4.484 $\pm$ 0.030 <sup>ab</sup>
Week 8	4.492 $\pm$ 0.098 <sup>a</sup>	4.389 $\pm$ 0.098 <sup>a</sup>	4.628 $\pm$ 0.098 <sup>a</sup>

Mean bearing the same superscripts letters are not significantly different ( $P > 0.05$ ).

**Table 3: Variations of yeast and molds counts of vanilla and coconut ice cream samples made from camel milk during the storage**

Storage period	Vanilla (cfu/g)	Coconut (cfu/g)	Vanilla and Coconut (cfu/g)
Week 1	3.239±0.195 <sup>a</sup>	3.301±0.195 <sup>a</sup>	3.3010±0.195 <sup>a</sup>
Week 2	3.943±0.152 <sup>a</sup>	3.151±0.152 <sup>b</sup>	3.6505±0.152 <sup>a</sup>
Week 3	4.241±0.063 <sup>a</sup>	4.423±0.063 <sup>a</sup>	4.2386±0.063 <sup>a</sup>
Week 4	4.489±0.085 <sup>a</sup>	4.554±0.085 <sup>a</sup>	4.5851±0.085 <sup>a</sup>
Week 5	4.484±0.042 <sup>a</sup>	4.412±0.042 <sup>a</sup>	4.4065±0.042 <sup>a</sup>
Week 6	4.454±0.069 <sup>a</sup>	4.335±0.069 <sup>a</sup>	4.3217±0.069 <sup>a</sup>
Week 7	4.574±0.083 <sup>a</sup>	4.396±0.083 <sup>a</sup>	4.5106±0.083 <sup>a</sup>
Week 8	4.538±0.029 <sup>a</sup>	4.568±0.029 <sup>a</sup>	4.6066±0.029 <sup>a</sup>

Mean bearing the same superscripts letters are not significantly different (P>0.05).

**Table 4: Variations of psychrotrophic count of vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla (cfu/g)	Coconut (cfu/g)	Vanilla and Coconut (cfu/g)
Week 1	4.2899±0.0627 <sup>a</sup>	3.7720±0.0627 <sup>c</sup>	4.0207±0.0627 <sup>b</sup>
Week 2	4.3116±0.0245 <sup>a</sup>	4.3613±0.0245 <sup>a</sup>	4.3217±0.0245 <sup>a</sup>
Week 3	4.3768±0.0522 <sup>b</sup>	4.4978±0.0522 <sup>ab</sup>	4.6173±0.0522 <sup>a</sup>
Week 4	4.4889±0.0803 <sup>a</sup>	4.5106±0.0803 <sup>a</sup>	4.5851±0.0803 <sup>a</sup>
Week 5	4.5642±0.0759 <sup>a</sup>	4.2657±0.0759 <sup>b</sup>	4.5810±0.0759 <sup>a</sup>
Week 6	4.2297±0.0381 <sup>b</sup>	4.6058±0.0381 <sup>a</sup>	4.3116±0.0381 <sup>b</sup>
Week 7	4.5246±0.0212 <sup>a</sup>	4.4911±0.0212 <sup>a</sup>	4.3323±0.0212 <sup>b</sup>
Week 8	4.6015±0.0459 <sup>a</sup>	4.4698±0.0459 <sup>a</sup>	4.5285±0.0459 <sup>a</sup>

Mean bearing the same superscripts letters are not significantly different(P>0.05)

### 3.1.2 Yeast and molds count

Result in Table 3 showed the means for yeast and molds counts of camel milk ice cream during the storage. There were non-significant (P>0.05) differences between the different types of ice cream. The highest value of yeast and molds counts was recorded for vanilla and coconut ice cream (log 4.61±0.03) after eight week of storage, while the lowest value was obtained for coconut ice cream samples during the second week (log 3.94±0.15) of storage.

### 3.1.3 Psychotrophic count

The means for psychotrophic bacterial count of flavored camel milk ice cream samples showed non-significant (P>0.05) differences in different types of ice cream during the second, fourth and eighth weeks of storage (Table 4). The values were significantly (P<0.05) different during the first, third, fifth, sixth and seventh weeks of storage between the different types of ice cream samples. The highest value of psychotrophic bacterial count was obtained

in ice cream made using the mixture of vanilla and coconut during the third week (log 4.62±0.05) of storage. However the lowest value was obtained in coconut ice cream during the first week (log 3.78±0.06) of storage (Table 4).

## 3.2 Sensory characteristics of ice cream from camel milk

Data in Table 5 showed some sensory measurements of flavored ice cream made from camel milk during the storage period. The mean of sensory measurements revealed significant (P<0.05) differences for all flavored ice cream samples. The higher means of texture and appearance scores were reported for coconut ice cream, while the higher flavor, taste and acceptability scores were reported in vanilla and coconut ice cream.

### 3.2.1 Texture

The texture score revealed significant (P<0.05) differences between the different types of

flavored camel milk ice cream during the storage period except during the second and eighth weeks. The highest mean of texture score was recorded for coconut ice cream during the fourth week ( $4.70 \pm 0.22$ ) of storage. However the lowest mean was found for

vanilla ice cream during the last week ( $1.90 \pm 0.24$ ) of storage (Table 6). **3.2.2 Taste**  
The present result showed significant ( $P < 0.05$ ) differences between the flavored ice cream made from camel milk only during the last two weeks (7 and 8) of storage as shown in Table 7.

**Table 5: The sensory characteristics of vanilla and coconut ice cream made from camel milk**

Sensory measurements		Vanilla ice cream	Coconut ice cream	Vanilla and Coconut ice cream
Texture score	Means $\pm$ sd.	$3.74 \pm 0.28^b$	$3.84 \pm 0.28^a$	$3.75 \pm 0.28^b$
	Maximum	4.4	4.7	4.4
	Minimum	1.9	3	2.1
Taste score	Means $\pm$ sd.	$4.05 \pm 0.38^a$	$3.80 \pm 0.38^b$	$4.35 \pm 0.38^a$
	Maximum	4.6	4.2	4.8
	Minimum	3.4	3.1	3.8
Flavor score	Means $\pm$ sd.	$3.94 \pm 0.35^b$	$3.81 \pm 0.35^b$	$4.25 \pm 0.35^a$
	Maximum	4.6	4.5	4.7
	Minimum	3.1	3	3.9
Appearance score	Means $\pm$ sd.	$4.36 \pm 0.28^b$	$4.71 \pm 0.28^a$	$4.45 \pm 0.28^b$
	Maximum	5	5	4.9
	Minimum	4	4	4
Acceptability score	Means $\pm$ sd.	$4.28 \pm 0.32^{ab}$	$4.00 \pm 0.32^b$	$4.39 \pm 0.32^a$
	Maximum	4.8	4.5	4.8
	Minimum	3.8	3.3	3.4

Mean bearing the same superscripts letters are not significantly different ( $P > 0.05$ ).

**Table 6: Average texture score of vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla	Coconut	Vanilla and Coconut
Week 1	$3.90 \pm 0.32^a$	$3.70 \pm 0.32^a$	$3.60 \pm 0.32^a$
Week 2	$4.40 \pm 0.24^a$	$3.90 \pm 0.24^b$	$4.40 \pm 0.24^a$
Week 3	$3.30 \pm 0.34^a$	$3.30 \pm 0.34^a$	$3.80 \pm 0.34^a$
Week 4	$4.40 \pm 0.22^a$	$4.70 \pm 0.22^a$	$4.30 \pm 0.22^a$
Week 5	$4.00 \pm 0.32^a$	$4.10 \pm 0.32^a$	$4.10 \pm 0.32^a$
Week 6	$4.10 \pm 0.14^a$	$4.10 \pm 0.14^a$	$4.10 \pm 0.14^a$
Week 7	$3.90 \pm 0.41^a$	$3.90 \pm 0.41^a$	$3.60 \pm 0.41^a$
Week 8	$1.90 \pm 0.24^b$	$3.00 \pm 0.24^a$	$2.10 \pm 0.24^b$

Mean bearing the same superscripts letters are not significantly different ( $P > 0.05$ ).

**Table 7: Average taste score of vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla	Coconut	Vanilla and Coconut
Week 1	$3.40 \pm 0.43^a$	$3.10 \pm 0.43^a$	$3.80 \pm 0.43^a$
Week 2	$4.50 \pm 0.31^a$	$4.00 \pm 0.31^a$	$4.30 \pm 0.31^a$
Week 3	$3.40 \pm 0.57^a$	$3.40 \pm 0.57^a$	$4.10 \pm 0.57^a$
Week 4	$4.30 \pm 0.32^a$	$4.20 \pm 0.33^a$	$4.60 \pm 0.32^a$
Week 5	$4.20 \pm 0.42^a$	$3.80 \pm 0.42^a$	$4.50 \pm 0.42^a$
Week 6	$4.20 \pm 0.41^a$	$4.20 \pm 0.41^a$	$4.20 \pm 0.41^a$
Week 7	$3.80 \pm 0.33^b$	$3.60 \pm 0.33^b$	$4.50 \pm 0.33^a$
Week 8	$4.60 \pm 0.26^{ab}$	$4.10 \pm 0.26^b$	$4.80 \pm 0.26^a$

Mean bearing the same superscripts letters are not significantly different ( $P > 0.05$ ).



The highest mean value of taste score was obtained for vanilla and coconut mixture ice cream samples during the eighth week ( $4.80\pm 0.26$ ), while the lowest mean score was obtained for coconut samples during the first week ( $3.10\pm 0.43$ ) of storage (Table 7).

### 3.2.3 Flavor

Result in Table 8 showed the means for flavor score of flavored ice cream made from camel milk during the eight weeks of storage. There were significant ( $P<0.05$ ) differences between the different types of ice cream during the seven weeks of storage. The highest mean of flavor score was recorded for the mixture of vanilla and coconut samples during the last week ( $4.70\pm 0.23$ ) of the storage, while the lowest mean was obtained for coconut ice cream during the third ( $3.00\pm 0.49$ ) week of storage.

### 3.2.4 Appearance

The score for appearance of camel milk ice cream as was recorded by the panelist was significantly ( $P<0.05$ ) different using the different flavors. The storage period showed some non-significantly variations between camels milk ice cream (Table 9). The highest means of appearance score was obtained for vanilla ice cream during the third week ( $5.00\pm 0.08$ ) of storage followed by coconut ice cream during the second, third, fourth, seventh and eight weeks. Similarly the lowest means score for appearance were obtained for each of ice cream made with vanilla and coconut during the first and sixth weeks of storage ( $4.00\pm 0.48$  and  $4.00\pm 0.47$ , respectively) and that made from the mixture of vanilla and coconut during the sixth week ( $4.00\pm 0.47$ ) of storage.

### 3.2.5 General acceptability of camel milk ice cream

The acceptability score revealed significant ( $P<0.05$ ) differences between different types of ice cream during the third, fourth, fifth and eighth weeks of storage (Table 10). The highest mean of acceptability were recorded for vanilla ice cream during the fourth week ( $4.8\pm 0.20$ )

and the mixture of vanilla and coconut ice cream during the fifth and eighth weeks of storage ( $4.80\pm 0.32$  and  $4.80\pm 0.2$ , respectively). However the lowest acceptability mean score was recorded for coconut ice cream during the third week ( $3.30\pm 0.44$ ) of storage.

## 4. DISCUSSION

The present study was designed to assess the microbial and acceptability of ice cream processed from camel milk using natural additives. This because the use of natural additives in ice cream mix may play an important role because the addition of chemical additives such as industrial color and flavor to food might create health risk to consumers (Penman et al., 2006).

The result of total bacterial count of ice cream made from camel milk was significantly affected by the type of flavors used (Table 1). This result agreed with El Owni and Khater (2011) who reported that the total bacterial count was significantly affected by the flavors used in ice cream. The minimum value of total bacterial count was reported in coconut ice cream compared with other samples might be because the coconut has antimicrobial substance (Mary, 1999). Similarly yeast and mold count showed significantly ( $P<0.05$ ) lower values in coconut ice creams samples (Table 1) made from camel milk. Similarly El Owni and Khater (2011) found that yeast and molds counts were significantly affected by flavors used in ice cream. The present result showed that the coliform bacteria were not detected in all ice cream samples during storage, which indicated the proper pasteurization of camel milk. The obtained values for total bacterial count and the coliform count were lower than those stated by SSMO (2005), which stated that the minimum and maximum acceptable microbiological limits for aerobic plate count and coliforms in ice cream are ( $10^4$  and  $10^5$ ) and ( $10$  and  $10^2$ ), respectively, in 25 grams.

**Table 8: Average flavor score of vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla	Coconut	Vanilla and Coconut
Week 1	3.10±0.45 <sup>a</sup>	3.10±0.45 <sup>a</sup>	3.90±0.45 <sup>a</sup>
Week 2	4.50±0.33 <sup>a</sup>	4.10±0.33 <sup>a</sup>	4.20±0.33 <sup>a</sup>
Week 3	3.50±0.49 <sup>a</sup>	3.00±0.49 <sup>a</sup>	3.90±0.49 <sup>a</sup>
Week 4	4.60±0.29 <sup>a</sup>	3.90±0.29 <sup>a</sup>	4.70±0.29 <sup>a</sup>
Week 5	4.00±0.33 <sup>a</sup>	4.10±0.33 <sup>a</sup>	4.30±0.33 <sup>a</sup>
Week 6	4.00±0.29 <sup>a</sup>	4.00±0.29 <sup>a</sup>	4.00±0.29 <sup>a</sup>
Week 7	3.40±0.38 <sup>b</sup>	3.80±0.38 <sup>ab</sup>	4.30±0.38 <sup>a</sup>
Week 8	4.40±0.23 <sup>a</sup>	4.50±0.23 <sup>a</sup>	4.70±0.23 <sup>a</sup>

Mean bearing the same superscripts letters are not significantly different (P>0.05).

**Table 9: Average appearance score for vanilla and coconut ice cream samples made from camel milk during storage**

Storage period	Vanilla	Coconut	Vanilla and Coconut
Week 1	4.00±0.48 <sup>a</sup>	4.00±0.48 <sup>a</sup>	4.10±0.48 <sup>a</sup>
Week 2	4.20±0.27 <sup>b</sup>	5.00±0.27 <sup>a</sup>	4.40±0.27 <sup>b</sup>
Week 3	5.00±0.08 <sup>a</sup>	5.00±0.08 <sup>a</sup>	4.90±0.08 <sup>a</sup>
Week 4	4.30±0.25 <sup>b</sup>	5.00±0.25 <sup>a</sup>	4.30±0.25 <sup>b</sup>
Week 5	4.30±0.31 <sup>a</sup>	4.70±0.31 <sup>a</sup>	4.50±0.31 <sup>a</sup>
Week 6	4.00±0.47 <sup>a</sup>	4.00±0.47 <sup>a</sup>	4.00±0.47 <sup>a</sup>
Week 7	4.50±0.23 <sup>b</sup>	5.00±0.23 <sup>a</sup>	4.60±0.23 <sup>ab</sup>
Week 8	4.60±0.17 <sup>b</sup>	5.00±0.17 <sup>a</sup>	4.80±0.17 <sup>ab</sup>

Mean bearing the same superscripts letters are not significantly different (P>0.05).

**Table 10: Average acceptability score of ice cream samples made from camel milk**

Storage period	Vanilla	Coconut	Vanilla and Coconut
Week 1	3.90±0.41 <sup>a</sup>	3.90±0.41 <sup>a</sup>	3.40±0.41 <sup>a</sup>
Week 2	4.50±0.29 <sup>a</sup>	4.10±0.29 <sup>a</sup>	4.30±0.29 <sup>a</sup>
Week 3	3.80±0.44 <sup>ab</sup>	3.30±0.44 <sup>b</sup>	4.30±0.44 <sup>a</sup>
Week 4	4.80±0.20 <sup>a</sup>	4.20±0.20 <sup>b</sup>	4.60±0.20 <sup>ab</sup>
Week 5	4.10±0.32 <sup>b</sup>	3.80±0.32 <sup>b</sup>	4.80±0.32 <sup>a</sup>
Week 6	4.50±0.32 <sup>a</sup>	4.50±0.32 <sup>a</sup>	4.50±0.32 <sup>a</sup>
Week 7	4.20±0.31 <sup>a</sup>	4.10±0.31 <sup>a</sup>	4.40±0.31 <sup>a</sup>
Week 8	4.40±0.23 <sup>ab</sup>	4.10±0.23 <sup>b</sup>	4.80±0.2 <sup>a</sup>

Mean bearing the same superscripts letters are not significantly different (P>0.05)

The result of microbial count in ice cream made from camel milk revealed non significant variations for total bacterial, yeast and molds and psychrotrophic bacterial counts during storage. This might be because all samples of ice cream were manufactured using the same procedures and kept in similar condition. Moreover the high osmotic potential of honey, which is due mainly to its high sugar concentration, might lead to the breakdown of bacterial membranes and thus inhibiting microbial growth (Bradbear et al., 2004). Also the combination of camel milk and honey may prove to be important source of nutrition and

for protection against microbial infection, as was stated by Al-Jabri (2005). During the storage period, the ice cream samples showed non significant variations in microbial loads (Table 1, 2, 3 and 4). This could be attributed to the numbers of bacteria, which are present in ice cream depend very largely upon the numbers and types of raw materials, especially milk and production line (Eckles and Macy, 1951).

The best taste scores for camel ice cream samples were obtained for vanilla followed by the mixture of vanilla and coconut ice cream samples compared to coconut ice cream. The

neutral flavors like vanilla pods give the ice cream made from camel milk good taste and flavor because it has flavoring substance. This supported Goodenough (1982) who reported that the pods (beans) of vanilla are the source of the popular flavoring substance “vanillin”. Vanilla bean is tropical aromatic orchid widely used in aroma industries for its flavor, mainly due to phenolic compounds (Gassenmeier et al., 2008). Moreover Robinson (1981) reported that most of ice cream is flavored by the addition of natural or synthetic flavors. A very large amount of vanilla (either bean, vanilla or a mixture of these) is made and second most popular flavors is strawberry or raspberry, with chocolate coming third. The present study observed that camel milk had sharp taste (mineral like) and predominant grassy flavor, with slightly salty taste and the combination of vanilla and coconut in ice cream has hidden the grassy taste of camel milk. However the highest appearance scores were recorded for coconut ice cream, which might be due to its white colour. The lowest values found in vanilla ice cream samples supported El Owni and Khater (2010) who reported that the poorest color scores were in ice cream made from vanilla. On the other hand, Del Giovine and Piccioli (2003) reported that ice cream plays an important role of actual food which, besides its digestive and metabolic qualities, has nutritive qualities, but can also influence the mind because of its organoleptic characteristics and its importance as thermoregulatory food in the fight against heat. All sensory measurements have significant effect in the different flavors used. This result supported El Owni and Khater (2010) who reported that color, texture, taste and overall acceptability were significantly affected by the flavor. The present result were also in accord to the finding of Arbuckle (1966) who showed that the body and texture characteristics are closely associated and are important in influencing consumer's acceptance of ice cream and related products. The texture of the ice cream depends on many factors such as the state of aggregation of the fat globules, the amount of air, the size of the air cells, the

viscosity of the aqueous phase, and the size and state of aggregation of ice crystals (Bolliger et al., 2000; Aime et al. 2001; Caillet et al. 2003; Granger et al. 2005).

#### 4. CONCLUSIONS

The present study concluded that the microbial loads were significantly affected by the different added flavors to the ice cream and coconut ice cream revealed the best microbial quality. Combination of vanilla and coconut showed higher acceptability for the taste of camel milk ice cream. However further studies should be done for making ice cream from camel milk by adding fruits to enrich nutritional and health benefit and to give nice flavor.

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