EFFECT OF VANILLA, BAOBAB (*Adanosonia digitata*) AND PAPAYA (*Carica papaya*) FRUITS ON THE MICROBIOLOGICAL AND SENSORY PROPERTIS OF CAMEL MILK ICE CREAM

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Abstract
Ice cream was made from camel milk using sugar, cream and Gum Arabic). Baobab (3 and 5%) and Papaya (3 and 5%) fruits were used as flavoring ingredients of the ice cream, while Vanilla (3%) was added as a control. Then, plastic cups were used for packing the ice cream, the storage was done in a freezer at -18ºC for eight weeks. Evaluations for microbiological counts and sensory attributes were conducted bimonthly. Significant (P<0.05) differences were obtained for total bacterial count and yeast and mould counts. Moreover the significantly (P<0.05) high count was found in Papaya ice cream samples. The coliform was not detected in all ice cream samples during the storage. The sensory evaluation revealed significant (P<0.05) differences for the means scores between all types of the ice cream. The highest scores for color, taste and texture (P<0.05) were found for Vanilla followed by Papaya (3% and 5%) ice cream samples. However high significant (P<0.05) differences in flavor scores were found for Vanilla and Baobab (3% and 5%) and Papaya 3% ice cream samples ice cream samples. It was concluded that adding Baobab and Papaya fruits (3%) for making ice cream camel milk improve its organoleptic properties as good flavor was reported.

Key words: Ice cream, sugar, Baobab, Papaya fruits.

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INTRODUCTION

The development of new food products and flavors with potential health benefits result increasing sales and consumers satisfaction (Cruz *et al*., 2009). Ice cream is considered as a mixture of air, water, milk fat or non-dairy fats, milk solids-not-fat (MSNF), sweeteners, stabilizers, emulsifiers, and flavors (Wiwat, 2012). Ice cream is a delicious and nutritious frozen dairy dessert with high calorie food value (Sengul and Ertugay, 2005; Temiz and Yeşilsu, 2010). The flavors used commonly in ice cream include Vanilla (Aime *et al.* 2001; Gantait *et al.*, 2011) and coconut (CheMan and Marina, 2006). The texture of the ice cream is influence by 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).

The storage conditions affected the shelf life of ice cream that could be extended from only two weeks for up to a year and a shelf life of about 12-18 months will be obtained if the produces is kept at around -20°C to -25°C (Marshall *et al.*, 2003; Lee *et al.*, 2005).

Baobab has a high amount of vitamin B1 and B2 (Adedayo *et al.*, 2011). Because of its high natural vitamin C content, Baobab fruit pulp has a good antioxidant property (Singh *et al*, 2013). Papaya is a powerhouse of nutrients and is available throughout the year. It is a rich source of three powerful antioxidant vitamin C, vitamin A and vitamin E; the minerals, magnesium and potassium; the B vitamin pantothenic acid and folate and fiber (Saran, 2013).

Some bioactive components that found naturally in camel milk (Agrawal *et al*., 2007; El-Agamy, 2007; Yadav, 2015); or derived from camel milk proteins using probiotic

strains (Elayan *et al*., 2008; Quan *et al*., 2008) were reported to have health benefit benefits.
Camel milk ice cream was first described by Abu-Lehia *et al*. (1989). Ahmed and El Zubeir (2015b) compared the properties of Vanilla and Coconut ice cream processed from camel milk by using natural mixture.
This study was designed to evaluate microbial loads, shelf life and sensory characteristics of camel milk ice cream using Baobab (*Adanosonia digitata*) and Papaya (*Carica Papaya*) fruits in comparison to Vanilla ice cream.

MATERIALS AND METHODS

2.1 Material

The present trials for making camel milk ice cream were done at the Department of Food Science and Technology, Faculty of Agriculture, during the period from December 2016 to February 2017. Fresh raw whole camel milk and Vanilla were purchased from local market in Khartoum North. The Baobab and Papaya were obtained from Central market of Khartoum. The cultures media were obtained from Merck (Darmstadt, Germany).
The chemical content of camel milk used was 10.99% solids non-fat, 5.43% fat, 4.38% protein, 5.97% lactose and 1.09% ash.

2.2 Preparation of fruits

The baobab (*Adanisonia digitata*) fruits pulp was prepared by removing the outer shell and the pulp was broken down mechanically, then the powder was collected, filtered and mixed with camel milk (3.0 L). The obtained mixture was collected and added to the mix of ice cream that was already prepared.
To prepare papaya (*Carica papaya*) fruit pulp, it was fist washed with clean water. The peels were removed with the help of a sharp knife, and then the seeds were removed from papaya manually. After that the papaya fruit pulp was cut into slices and mixed using a homogenizer, it was filtered and mixed with camel milk (3.0 L). Then the mixture was added to the ice cream mix as was done for Baobab.

2.3 Manufacturing of ice cream

Ice cream samples were made from camel milk using five flavors (3% Vanilla, 3% and 5% Baobab and 3% and 5% Papaya) using the same percentage of sugar (15%), cream (5%) and Gum Arabic (0.5%), for 20 litter of pure camel milk. First, the milk was heat treated at 72 ºC for 15 second according to Hatterm *et al.* (2011) and then Bababo or Papaya in addition to Gum Arabic and cream were added, while homogenizing the mix. The mix was put in the refrigerator for 5 ºC, and was divided into 5 portions and the fruits were added. Then each mix was derived into ice cream machine and the ice cream with 5 levels of fruits; Vanilla, Baobab and Papaya were made. The packing was done into plastic cups; size 60 grams; and stored at -18 ºC in a freezer for eight weeks.

2.4 Determination of microbiological loads of ice cream

The equipment (flasks, test tubes, pipettes and Petri dishes) were sterilized using hot air oven (160˚ C for 60 minutes). The media were sterilized using autoclave (121˚C for 15 minutes). After cooling (45-46˚ C), the media were poured into duplicate of Petri dishes (Singleton, 1992). The procedure described by Marshall (1992) was followed to prepare the ice cream samples by mixing one gram of ice cream sample with sterile distilled water (1:10) and then diluted serially (10^{-1}- 10^{6}). After thorough mixing of the sample, one ml from each of the selected dilution was transferred carefully into the Petri dishes using sterile pipettes.
Enumeration of total bacterial count was done on plate count agar (Houghtby *et al*., 1992). Macconkey agar was used for enumeration of coliform bacteria (Christen *et al*., 1992) and enumeration of yeast and mould was done according to Frank *et al*. (1992). The incubation of the plates for total bacterial count were done at 37˚ C for 48 hours, while coliform bacteria and yeast and mould counts were done at 37˚C for 24 hours and 25 ºC for 5 day, respectively.

2.5 Sensory evaluation

Appearance, flavor, texture, taste and overall acceptability of different types of ice cream were evaluated by ten untrained panelists based on the 5- Scales Hedonic Rating scale (Juyun,

2011). The scores were ranged from 5 (excellent) to 1 (poor).

2.6 Statistical analysis

The obtained data were statistically analyzed using by factorial experiment 2X2. ANOVA test was used to determine the significant level of the treatments, and the least significant difference was used for mean separation at P≤ 0.05. The analysis was conducted using SPSS (version 21) package program.

RESULTS AND DISCUSSION

3.1 The microbial counts of ice cream form camel milk

Total bacterial count

Significant (P<0.05) variations were found in the total bacterial count of ice cream flavored with different fruits (Table 1). Also the storage period showed significant (P<0.05) differences for the total bacterial count in the different ice cream samples (Table 2). The total bacterial count was high in Papaya 5% (log 2.20±0.37) ice cream and low in Baobab 5% (log 1.35±0.62) ice cream. The total bacterial count in day one (log 2.05±0.63) showed its highest value, than deceased gradually until it reached the lowest mean at week eight (log 1.72±0.63) as shown in Figure 1.

Yeast and mould count

The different types of ice cream showed significant (P<0.05) variations in the yeast and mould counts (Table 1). The highest value of total yeast and mould counts (log 1.96±0.48 and 2.05±0.49) were found in Baobab (3%) and Papaya (5%) respectively, while the lowest value (log 1.73±0.35) was estimated for Baobab (5%). The storage period also revealed significant (P<0.05) differences for the different flavored ice cream samples. Week eight showed the highest value (log 2.29±0.34) for yeast and mould counts and during week two, the lowest value was found (log 1.42±0.51) as shown in Figure 2**.**

Coliform count

There was no growth of coliform bacteria in the different types of ice cream. The coliform count revealed non-significant (P>0.05) difference between different flavored ice cream (Table 1).

3.2 Sensory properties of camel milk ice cream

Camel milk ice cream flavored with different fruits revealed significant (P<0.05) differences in all sensory attributes measured. The higher means among all sensory characteristics was obtained for Vanilla ice cream (Table 2).

Color score

The color scores recorded by the panelist for ice cream made using camel milk showed highly significant (P<0.05) differences for the different flavoring fruits. The highest mean of color score was found in ice cream flavored with Vanilla (4.72±0.57), while the lowest mean of color score was obtained for Baobab (5%) ice cream (3.24±1.08) as illustrated in Table 2.

Table 1: The microbial counts (log) of Vanilla, Baobab and Papaya ice cream made from camel milk

Types of ice cream	Microbial loads (log)		
	Total bacterial count	Yeast and mould counts	Coliform count
Vanilla ice cream	1.81 ± 0.30^{b}	1.91 ± 0.38^{ab}	0.00
Baobab (3%) ice cream	1.94 ± 0.36^{b}	1.96 ± 0.48^{a}	0.00
Baobab (5%) ice cream	1.35 ± 0.62^{c}	1.73 ± 0.35^{b}	0.00
Papaya (3%) ice cream	2.00 ± 0.46^{ab}	1.89 ± 0.64^{ab}	0.00
Papaya (5%) ice cream	2.20 ± 0.37^{a}	2.05 ± 0.49^{a}	0.00
L.S	***	*	N.S

Means bearing similar superscripts letters in the same column are not significantly different (P>0.05)
N.S= Non Significant *= P<0.05 ***= P<0.001

Table 2: The sensory characteristics of Vanilla, Baobab and Papaya ice cream made from camel milk

Treatment	Sensory characteristics				
	Color scores	Flavor scores	Taste scores	Texture scores	Overall acceptability scores
Vanilla ice cream	4.72±057^{a}	4.04±1.10^{a}	3.94±1.11^{a}	3.96±1.29^{a}	4.18±1.06^{a}
Baobab 3% ice cream	3.78±1.93^{c}	3.56±1.19^{ab}	3.40±1.30^{b}	2.76±1.34^{b}	3.58±1.21^{b}
Baobab 5% ice cream	3.24±1.08^{d}	3.80±1.08^{ab}	3.84±1.01^{ab}	2.46±0.95^{b}	3.88±0.89^{ab}
Papaya 3% ice cream	4.28±0.73^{b}	3.60±1.29^{ab}	3.66±1.20^{ab}	3.78±1.14^{a}	3.76±1.09^{ab}
Papaya 5% ice cream	4.04±0.94^{bc}	3.50±1.16^{b}	3.62±1.14^{ab}	3.92±1.06^{a}	3.84±1.07^{ab}
L.S	***	*	*	***	*

Means bearing the same superscripts letters in the same column are not significantly different (P>0.05)
*= P<0.05
***= P<0.001

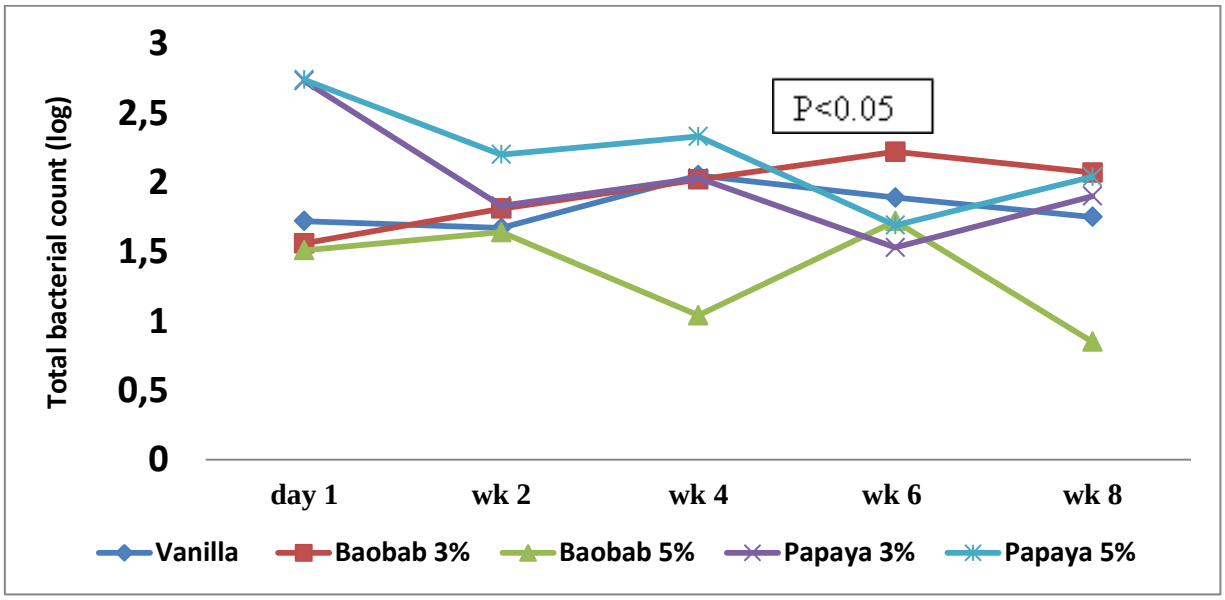

Figure 1: Variations of total bacterial count of Vanilla, Baobab and Papaya ice cream made from camel milk during storage

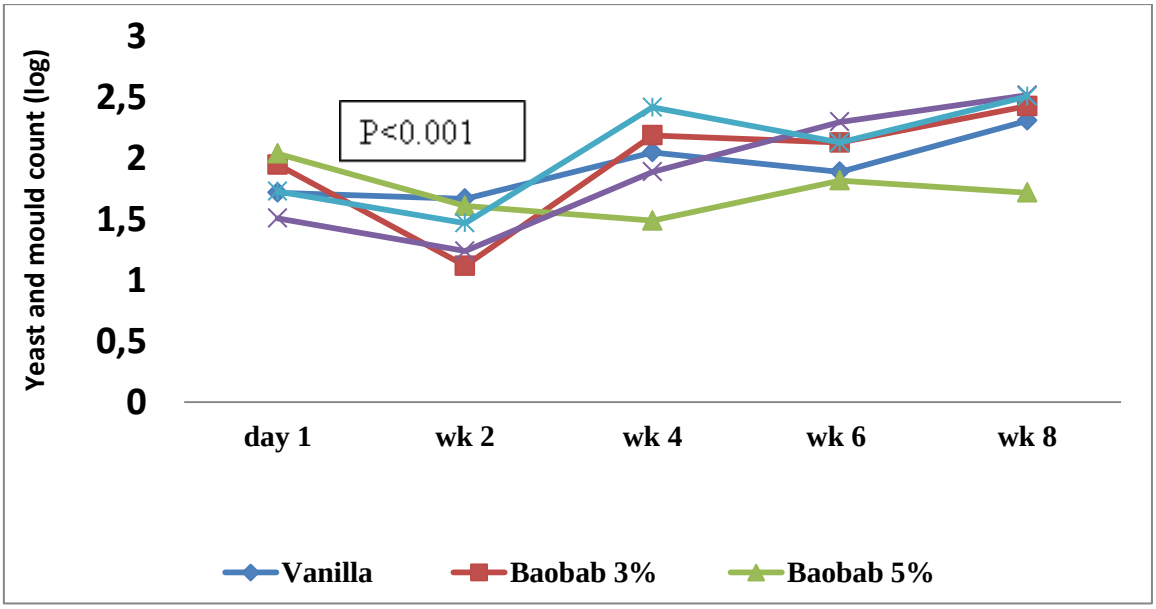

Figure 2: Variations of yeast and mould counts of Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

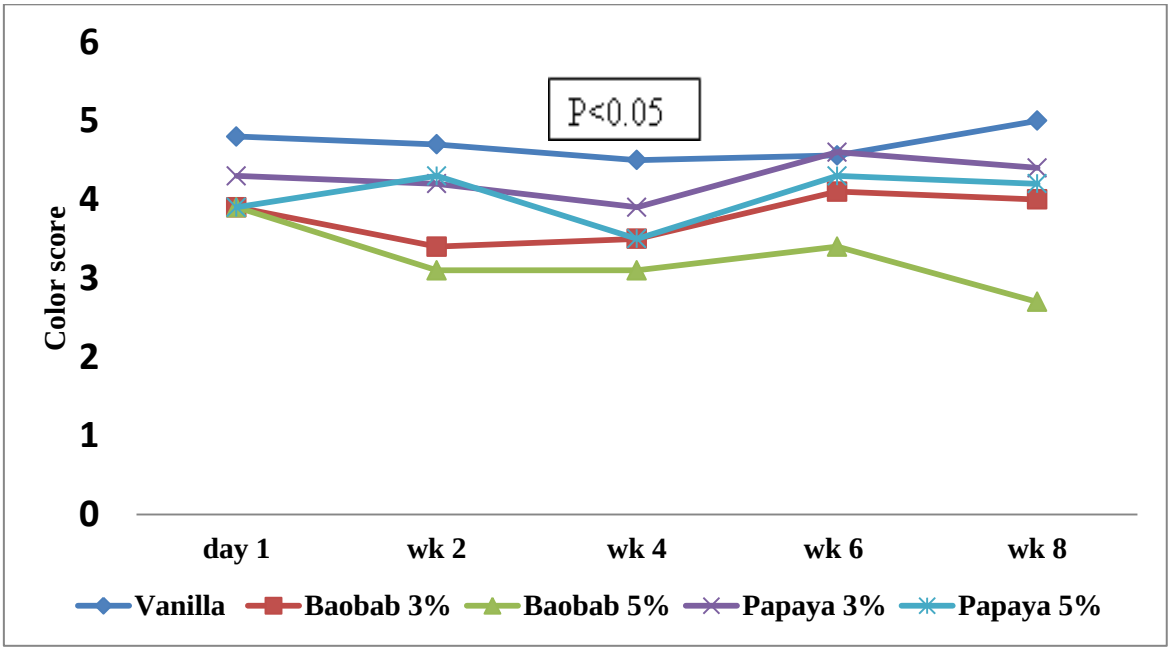

Figure 3: Scores of color for Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

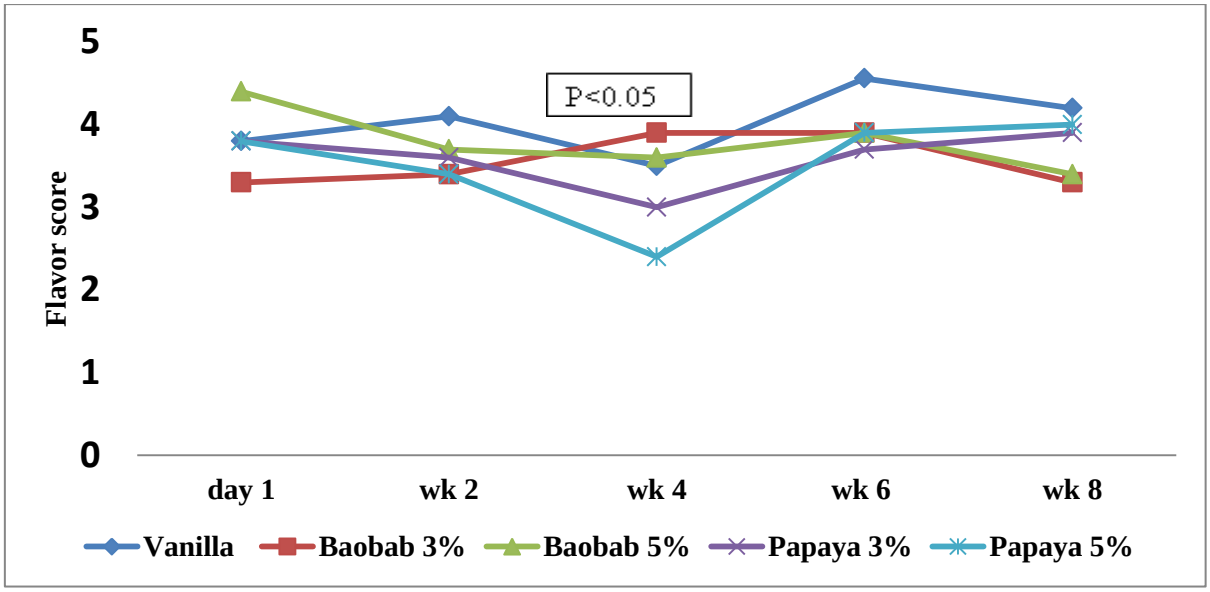

Figure 4: Scores of flavor for Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

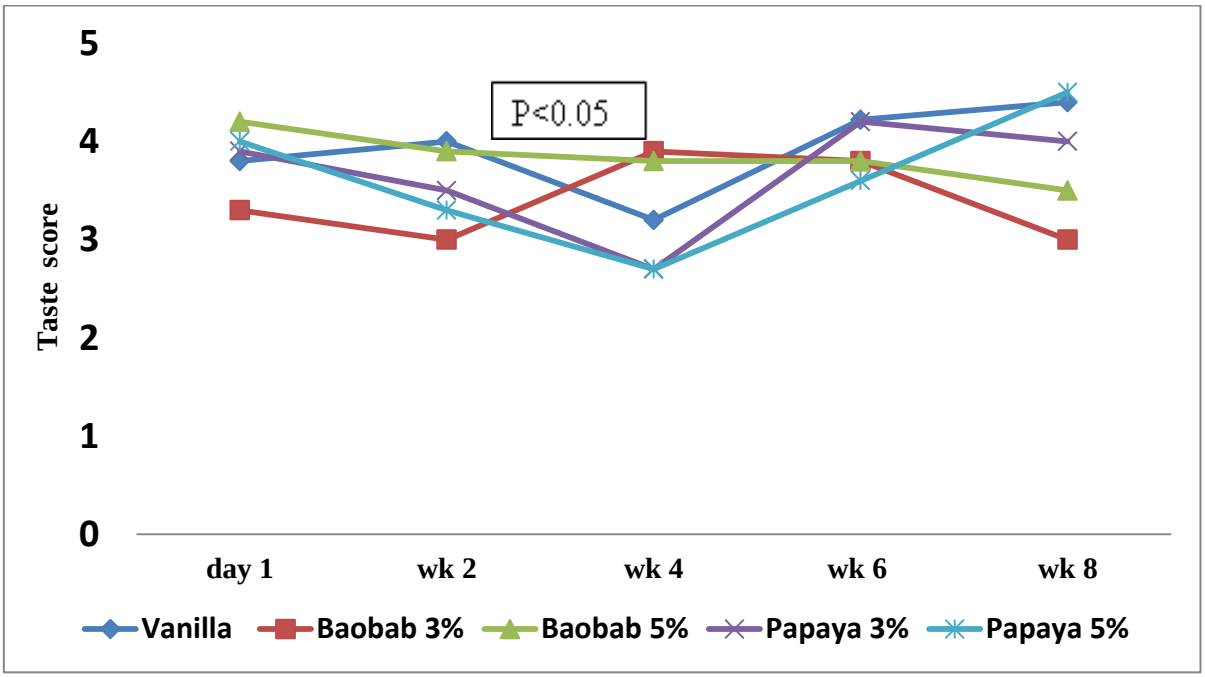

Figure 5: Scores of taste for Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

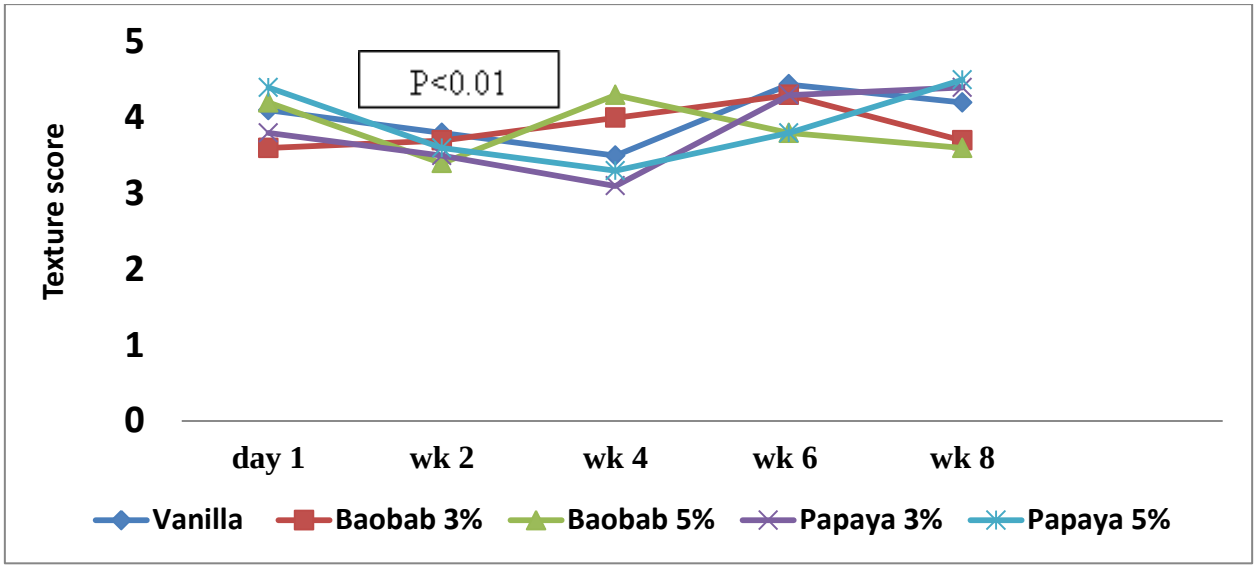

Figure 6 Scores of texture for Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

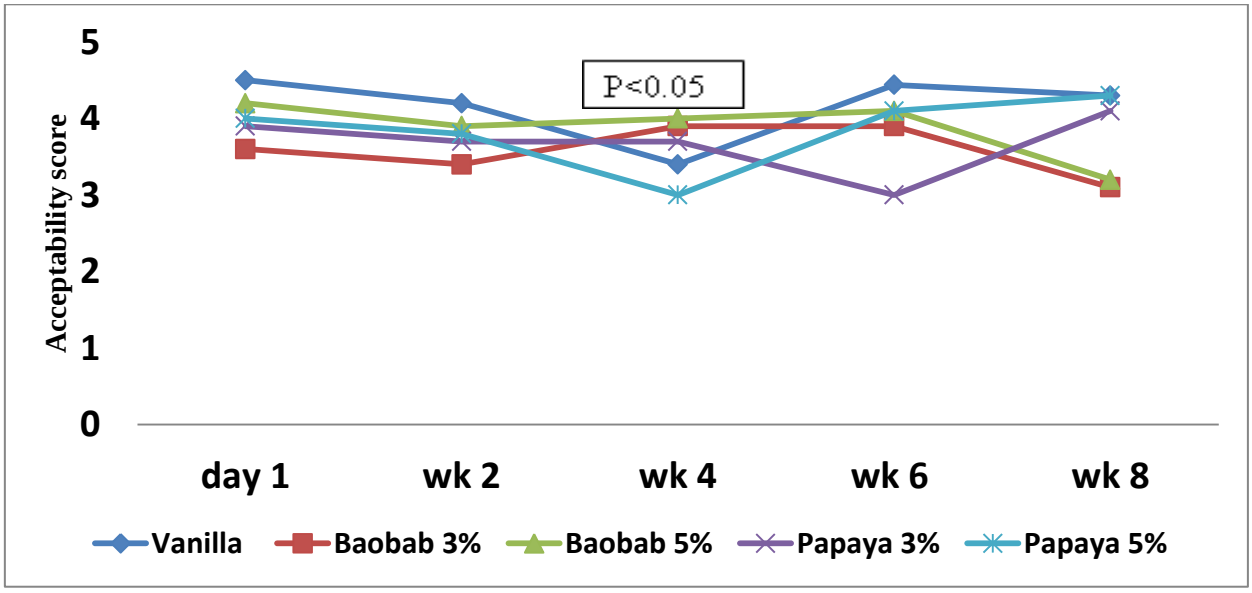

Figure 7 Scores of overall acceptability for Vanilla, Baobab and Papaya ice cream samples made from camel milk during storage

The result in Figure 3 showed that the highest score of color was found in ice cream flavored with Vanilla during the first (4.16±1.05) and six weeks (4.20±0.85) of storage, while the lowest score was found in week 4 (3.70±1.11).

Flavor score

The present result (Table 2) showed significant (P<0.05) differences in the flavor between the different flavored ice creams made from camel milk. The highest score was obtained in Vanilla ice cream (4.04±1.10) followed by Baobab (5% and 3%) ice cream (3.80±1.08 and 3.56±1.19, respectively), while the lowest score was reported for Papaya (5%) ice cream (3.50±1.16).

The highest mean of flavor score was obtained during the first, six and eight weeks of storage (3.82±1.35, 4.00±1.05 and 3.76±0.99,

respectively), while the lowest score was obtained in week 4 (3.28±1.26) as shown in Figure 4.

Taste score

Camel milk ice cream flavored with different fruits revealed significant (P<0.05) differences in the taste score (Table 2). The highest score was obtained in Vanilla ice cream (3.94±1.11) followed by Baobab (5%) and Papaya (3% and 5%) ice cream (3.84±1.0, 3.66±1.20 and 3.62±1.14 respectively), while the lowest score was reported for Baobab (3%) ice cream (3.40±1.30).

The data showed significant (P<0.05) differences between the flavored camel milk ice cream in week 1, 7 and 8 during the storage period (Figure 5). The highest mean value for taste score was found during day one (3.84±1.23), followed by week 4, week 6 and week 8 which revealed 3.26±1.25, 3.94±0.95 and 3.88±1.18, respectively (Figure 5).

Texture score

Significant (P<0.05) differences were found for texture score of ice cream made from camel milk using the different fruits as flavors (Table 2).

The high texture scores of ice cream was recorded for Vanilla, Papaya (3%) and Papaya (5%), which revealed 3.96±1.29, 3.78±1.14 and 3.92±1.06, respectively, however the lowest score was obtained for ice cream made from Baobab 5% (2.46±0.95). Also the storage period showed significant (P<0.05) variations for the different flavored ice cream samples (Figure 6). The highest mean value of texture score was found in day 1 (3.74±1.10) and the lowest texture score value was found in week 4 (2.92±1.35) as presented in Figure 6.

Overall acceptability of camel milk ice cream

The overall acceptability of different flavored ice cream revealed significantly (P<0.05) different scores (Table 2). Vanilla ice cream samples recorded the highest mean value (4.18±1.06), while there was no difference between the other types of ice cream in the overall acceptability scores.

The storage period revealed significantly (P<0.05) different acceptability scores for different flavored camel milk ice cream (Figure 7). The highest average of the overall acceptability scores were obtained in day 1 and week 6 (4.04±1.02 and 4.14±0.85, respectively). However there is no significant (P>0.05) difference for the interaction between the different treatments and storage period for overall acceptability score (Table 2).

Significant variations were obtained for total bacterial and yeast and mould counts of camel milk ice cream. The total bacterial count revealed its highest value in Papaya (5%) ice cream samples (Table 1 and Figure 1). However Chukwuemeka and Anthoni (2010) and Vijay *et al.* (2014) reported on the antimicrobial properties of Papaya. The present result agreed with El Owni and Khater (2011) reported significant differences in the total bacterial count using different juices as flavors. Also Ahmed and El Zubeir (2015a) showed that there was a significant difference of total bacterial counts and yeast and mould counts due to the different fruits that were used in camel milk ice cream. The lower mean for total bacterial count was found in Baobab (5%) ice cream samples. This suggested the antimicrobial properties of Baobab fruit pulp. Moreover Baobab fruit pulp has high natural vitamin C content Baobab fruit pulp has high antioxidant properties (Singh *et al.*, 2013). Moreover the high vitamin C and antioxidant content of the fruit pulp may have a role in decreasing the content of microbes and also play a role in the extension of shelf-life for foods and beverages (Adedayo *et al.*, 2011 and Singh *et al.*, 2013). Also, yeast and mould showed a significant different (P<0.05) effect according to the variation of fruits used in ice cream. The lowest count of yeast and mould was reported for Baobab (5%) ice cream samples (Table 1 and Figure 2). This could be because of the high antioxidant effect (Decaluwe and Van, 2010 and Singh *et al.*, 2013). Also El Owni and Khater (2011) Ahmed and El Zubeir (2015a) found that the different fruits added to flavor the camel milk ice cream have influence on the counts of yeast and mould. The comparatively lower microbial load found in the present study might be due to the antimicrobial properties of raw material

used; camel milk and fruits pulp. In addition the heat treatment of ice cream mix as well as the freezing storage to which the ice cream were kept. Heating of milk and fruits before processing is one of important factor for eliminating microbial load, which supported Mohamed and El Zubeir (2014). Moreover the presence of heat resistant antimicrobial factors in camel milk was documented (Wernery *et al.*, 2005 and Benkerroum, 2008).

All ice cream samples were found to be free from the coliform bacteria during storage, this because camel milk was pasteurized before making the ice cream. Mohamed and El Zubeir (2014) demonstrating the effect of heat treatment on camel milk previously. The obtained values for total bacterial count and the coliform count were lower than those stated by the Sudanese standards, which stated that the minimum and maximum acceptable microbiological limits for aerobic plate count and coliforms in 25 grams of ice cream should ranged from 10^4 to 10^5 and 10 to 10^2, respectively (SSMO, 2005). Similarly this result agreed with that found by Ahmed and El Zubeir (2015a) who reported that the coliform bacteria did not grow during storage of all ice cream samples, this could be due to the heat treatment and cold storage of ice cream of camel milk. Moreover Benkerroum (2008) found that camel milk containing a greater content of antimicrobial components compared to bovine or buffalo milk.

Camel milk ice cream flavored with Vanilla revealed the highest score for color (Table 2 and Figure 3), while the second color score was found in 3% Papaya ice cream samples. On the other hand, Baobab 5% showed the lowest color score. Camel milk, generally opaque and white, has an acceptable taste (El Zubeir and Jabreel, 2008). Also this study showed significant ($P<0.05$) variations for flavor scores in different fruits (Vanilla, Baobab and Papaya) used in ice cream made from camel milk. The highest score was found in Vanilla ice cream samples (Table 2 and Figure 4), while the second flavor scores was reported for Baobab 3% and Papaya 3%, where the lowest scores was reported in Papaya 5%.

The significant ($P<0.05$) differences reported for the different flavored camel milk ice cream were obtained for the taste score (Table 2 and Figure 5). The highest taste score was found in Vanilla followed by Baobab 5% and Papaya (3 and 5%) ice cream samples. Vanilla beans are considered as the source of the popular flavoring substance called vanillin (Goodenough, 1982). Vanilla bean is an aromatic orchid from the tropics that widely used as aroma and flavor in food industry, because of its phenolic compounds (Gassenmeier and Riesen, 2008). Robinson (1981) reported that addition of natural or synthetic flavors is used in most of ice cream. The Baobab also has the second score and the majority of the women like the Baobab (Tabaldi). This might be because of the pulp of a ripe fruit of Baobab has whitish appearance and slightly sour taste and flavor (Arum, 1989). Moreover recently the pulp has become a popular ingredient in ice products in urban areas (Gebauer *et al.*, 2002). It was observed that most of old people prefer the Papaya ice cream sample due to its good taste as they claimed, which might be because the Papaya is a juicy and tasty fruit due to its high content of sugars, The ripe fruit is consumed fresh for desert and in fruit salad or processed. It is highly accepted worldwide (Lobo and Cano, 1998; Nakasone and Paul, 1998; OECD, 2010).

The highest score of texture was found in Vanilla ice cream samples, while the lowest score of texture was found in Baobab 5% ice cream sample (Table 2 and Figure 6). This is could be due to the fact that Baobab (Tabaldi) have high amount of fiber (Cissé *et al.*, 2013) that affect the texture of Baobab ice cream samples. The soft texture of Papaya ice cream sample might be due to its low fiber content. Also Papaya has a high amount of papen enzyme activity that showed degradation capacity cellular systems that cause break down of the protein of ice cream (Nakasone and Paul, 1998; Dev and Iqbal, 2015). Finally, the overall acceptability showed slight differences between the different fruits flavored ice cream that made from camel milk (Table 2 and Figure 7). The higher scores were found

for ice cream samples flavored using Vanilla, followed by Baobab 5% and Papaya (3 and 5%) in comparison with those made from Baobab (3%).

The different sensory properties measured showed significant variations in the different flavored ice cream samples. This result supported Abdi El- Rahman *et al.* (1997) who found that the flavor of ice cream samples differed significantly ($P<0.05$). Similarly Butt *et al*. (1999) reported that the body, texture, flavor and taste were affected significantly due to the difference in stabilizer/emulsifier combination and storage period. Moreover the sensory properties (color, texture, taste and overall acceptability) of ice cream were significantly influenced by the flavors used (El Owni and Khater, 2011; Ahmed and El Zubeir, 2015a). Also Mohammed and El Zubeir (2019) concluded that processing and consumption of ice cream made by additives of natural flavors and fruits available in Sudan should be encouraged as they found that the highest scores for flavor and color were recorded in ice cream samples flavored by African fan palm fruits.

CONCLUSION

The different added flavors to the ice cream made using camel milk significantly affected total bacterial count and yeast and mould counts. The lowest values of total bacterial count and yeast and mould were found in Baobab ice cream samples. Also there was no growth of coliform in all types of ice cream.

The highest color and texture scores were recorded for ice cream samples using Vanilla (3%) and the lower score was found in Baobab (5%). Also the highest taste and flavor scores were found in Vanilla, followed by Baobab 5% and Papaya (3 and 5%) ice cream samples.

The practical importance of this study is the development of new products with functional properties by including some valuable fruits that will improve the quality of camel milk both for the consumers and dairy industry. Further research should be focus on making ice cream from camel milk by adding different fruits in order to enrich its health benefits and acceptability among consumers.

REFERENCES

[1] Abdi El- Rahman, A. M., Shalabi, S. I., Hollender, R. and Kilarara, A. (1997). Effect of milk fat fractions on the sensory evaluation of frozen desserts. J. Dairy Sci., 80:1936-1940.

[2] Abu-Lehia, I. H., Al-Mohiezea, I. S. and El-Behry, M. (1989). Studies on the production of ice cream from camel milk products. Australian Journal of Dairy Technology, 44:31-34.

[3] Adedayo, M. R., Olayemi, F. F. and Bamishaiye, E. I. (2011). Proximate and mineral composition of a local drink made from baobab fruit (*Adansonia digitata*) pulp. Advances in Bioresearch Journal, 2 (2): 82 - 85.

[4] Agrawal, R., Budania, S., Sharma, P., Gupta, R. and Kochar, D. (2007). Zero prevalence of diabetes in camel milk consuming Raica community of northwest Rajasthan, India. Diabetes Research and Clinical Practice, 76: 290-296.

[5] Ahmed, A. S. M. and El Zubeir, I. E.M. (2015a). Microbiological and sensory properties of low fat ice cream form camel milk using natural additives. Ann. Food Sci. Technol., 16: 236-244.

[6] Ahmed, A. S. M. and El Zubeir, I. E.M. (2015b). Processing properties and chemical composition of low fat ice cream made from camel milk using natural additives. International Journal of Dairy Science, 10 (6): 297-305.

[7] Aime, D., Arntfield, S. D., Malcolmson, L. J. and Ryland, D. (2001). Textural analysis of fat reduced vanilla ice cream products. Food Research International, (34): 237-246.

[8] Al Haj, O. A. and Al Kamal, H. A. (2010). Compositional, technological and nutritional aspects of dromedary camel milk. International Dairy Journal, 20: 811–821.

[9] Arum. G., (1989). The Baobab (*Adansonia digitata*) for health and completely natural wellbeing. www.baobab fruit co.com

[10] Benkerroum, N. (2008). Antimicrobial activity of lysozyme with special relevance to milk. African Journal of Biotechnology, 7: 4856-4867.

[11] Bolliger, S., Goff, H. D. and Tharp, B. W. (2000). Correlation between colloidal properties of ice cream mix and ice cream. International Dairy Journal, (10): 303-309.

[12] Butt, M. S., Ahmed, I., Mohmood, S. and Shahzadi, N. (1999). Effect of different combination of stabilizer/emulsifiers on the quality of ice cream. Pak. J. Agri. Sci., 36:360-362.

[13] Caillet, A., Cogne, C., Andrieu, J., Laurent, P. and Rivoire, A. (2003). Characterization of ice cream structure by direct optical microscopy. Influence of freezing parameters. Lebensmittel Wissenschaft und – Technologies, (36): 743-749.

[14] CheMan, Y.B. and Marina, A.M. (2006). Medium chain triacylglycerol. In: Shahidi, F. (Ed.), Nutraceutical and specialty lipids and their co-products. Boca Raton: Taylor and Francis Group. 27-56. Italy.
[15] Christen, G. L., Davidson, P.M., McAllister, J. S. and Roth, L. A. (1992). Coliform test with solids media. In: Standard Methods for the Examination of Dairy Products, 16th ed. Marshall, T. R. (ed). American Public Health Association, Washington, D.C. 267.
[16] Chukwuemeka, N. O. and Anthoni, A.B. (2010). Antifungal effects of pawpaw seed extracts and papain on post harvest *Carica papaya* L. fruit rot. Afri. J. Agri. Res., 5: 1531-1535.
[17] Cissé, I., Montet, D., Reynes, M., Danthu, P., Yao, B. and Boulanger, R. (2013). Biochemical and nutritional properties of baobab pulp from endemic species of Madagascar and the African mainland. African Journal of Agricultural Research, (8) 47: 6046-6054.
[18] Cruz, G. A., Antunes, E. C., Sousa, O. P., Faria, A. F. and Saad, M. I. (2009). Ice cream as a probiotic food carrier. Food Research International, 42: 1233–1239
[19] Decaluwe, E. and Van, D. (2010). *Adansonia digitata L.* – A review of traditional uses, Phytochemistry and Pharmacology, 23(1):11–51.
[20] Dev, N. and Iqbal, A. (2015). Processing and quality evaluation of green papaya (*Carica papaya L.*) leaf tea. Journal of Agriculture and Crop Science (2): 1–6.
[21] El Owni, O. A. O and Khater, Z. K. O. (2011). Microbial quality of ice cream produced in Khartoum State, Sudan. Australian Journal of Basic and Applied Sciences, 5(8): 716-719.
[22] El Zubeir, I.E.M. and Jabreel, M.S.O. (2008). Fresh cheese from camel milk coagulated with Camifloc. International Journal of Dairy Technology, 61: 90-95.
[23] El-Agamy, E. I. (2007). The challenge of cow milk protein allergy. Small Ruminant Research, 68: 64-72.
[24] Elayan, A. A., Sulieman, A. E. and Saleh, F. A. (2008). The hypocholesterolemic effect of Gariss and Gariss containing Bifidobacteria in rats fed on a cholesterol-enriched diet. Asian Journal of Biochemistry, 3:43-47.
[25] Frank, J. F., Christen, G. L. and Bullerman, L. B. (1992). Tests for group of microorganisms. In: Standard Methods for the Examination of Dairy Products, 16th ed. Marshall, T.R. (ed). American Public Health Association, Washington, D.C., 271-286.
[26] Gantait, S., Mandal, N. and Nandy, S. (2011). Advances in microprpagation of selected aromatic plant: A Review on vanilla and strawberry. American Journal of Biochemistry and Molecular Biology, 1: 1-19.
[27] Gassenmeier, K. and Riesen, B. (2008). Commercial quality and analytical parameters of cured vanilla beans (*Vanilla planifolia*) from different origins from the 2006-2007 crop. Flavor Frag. J., 23:194-201.
[28] Gebauer, J., El-Siddig, K. and Ebert G. (2002). Baobab (*Adansonia digitata L.*): A review on a multipurpose tree with promising future in the Sudan. Gartenbau Wissenschaft, 67 (4): 155–160.
[29] Goodenough, D. R. (1982). Vanilla, vanillin and vanillin derivatives. Bakers Dig., 56: 8-10.
[30] Granger, C., Leger, A., Barey, P., langendorff, V. and Cansell, M. (2005). Influence of formulation on the structural networks in ice cream. International Dairy Journal, (15): 255-262.
[31] Hattem, H. E., Manal, A. N., Hanna, S. S. and Elham, A. A. (2011). A study on the effect of thermal treatments on composition and some properties of camel milk. J. Dairy sci., 92: 857-862.
[32] Houghtby, G. A., Maturin, L. J. and Koening, E. K. (1992). Microbiological count methods. In: Standard for the Examination of Dairy Products, 16th ed. Marshall, T. R. (ed). American Public Health Association, Washington, D. C.219.
[33] Juyun, L, (2011). Food Quality and Preference. Food Quality and Preference, 22: 733–747.
[34] Lee, H., Stokols, J., Palchak, T. and Bordi, P. (2005). Effect of polyols versus sugar on the shelf life of vanilla ice cream. Food Serv. Res. Int., 16 (1): 44-52.
[35] Lobo, M. G. and Cano, M. P. (1998). Preservation of hermaphrodite and female papaya fruits (*Carica papaya L.*, cv. Sunrise, Solo group) by freezing: physical. physico-chemical and sensorial aspects. Zeitschrift Lebensmitteluntersuchung und – Forschung, 206 (5): 343–349.
[36] Marshall, R. T. (1992). Standard methods for examination for dairy products. 16th ed. American Public Health Association (APHA), Washington, DC. USA.
[37] Marshall, R. T., Goff, H. D. and Hartel, R. W. (2003). 'Ice Cream' 6th Ed, Kluwer Academic/Plenum Publishers, New York.
[38] Marshall, R.T. and W.S. Arbuckle, (1996). Ice Cream. 15th Edn., International Thomson Publ., New York, USA.
[39] Mohamed, I. M. A. and El Zubair, I. E. M. (2014). Effect of heat treatment on keeping quality of camel milk, Annals Food Science and Technology, 15(2): 239- 245.
[40] Mohammed, T. M. N. E. and El Zubeir, I. E. M. (2019). Evaluation of chemical composition and sensory properties of ice cream flavored with African Fan palm (*Borassus aethiopum)* and Muskmelon (*Cucumis melo L.*) fruits juices. J. Nutr. Food Sci., 2: 010.
[41] Nakasone, H. Y. and Paul, R. E. (1998). Tropical Fruits. CAB Intl, Wallingford, U.K., 445-450.

[42] OECD (2010). Consensus document on compositional consideration for new varieties of papaya (*Carica papaya*): Key food and feed nutrients, anti-nutrients, toxicants and allergens. www.eocd.org/biotrack.
[43] Quan, S., Tsuda, H. and Miyamoto, T. (2008). Angiotensin I-converting enzyme inhibitory peptides in skim milk fermented with *Lactobacillus helveticus* 130B4 from camel milk in Inner Mongolia, China. Journal of the Science of Food and Agriculture, 88: 2688-2692.
[44] Robinson, R. K. (1981). Dairy Microbiology, first ed., Applied Science Publishers London and New York.
[45] Saran, P. L. (2013). Drug bioavailability and traditional medicaments of commercially available papaya. African Journal of Agriculture Research, 8(25): 3216-3223.
[46] Sengul, M. and Ertugay, M. (2005). Rheological, physical and chemical characteristics of mulberry pekmez. Food Control, 16: 73–76.
[47] Singh, S., Parasharmi, V. and Rai, S. (2013). Medicinal uses of *Adansonia digitata*: An endangered tree species. Journal of Pharmaceutical and Scientific Innovation, 2(3):14-16.
[48] Singleton, P. (1992). Introduction to Bacteria, 2nd ed. John Wiley and Sons, New York.
[49] SSMO (2005). Sudanese Standards and Metrological Organization. Ice cream, ice cream mixes, combined milk ice cream and water base ice cream (SDS 308), Ministry of Cabinet of Ministers, Sudan Government. Monitory Printing Press Co., 2005, Sudan.
[50] Temiz, H. and Yesilsu, A. (2010). Effect of pekmez addition on the physical, chemical and sensory properties of ice cream. Czech J. Food Sci., 28: 538-546.
[51] Vijay, Y, Pradeep, K., Goyal, C. S, Chauhan, A. and Goyal, B. V. (2014). *Carica papaya* Linn: An overview. International Journal of Herbal Medicine, 2 (5): 01-08.
[52] Wernery, U, Johnson, B, Abrahm, A, (2005). The effect of short-term heat treatment on vitamin C concentrations in camel milk. Milchwissenschaft, 60:266-267. http://camelmilkforlife.com/admin/uploads/pubs/Heat%20Treatment%20Prelim.pdf
[53] Wiwat, W. (2012). Development of ginger flavored soya milk ice cream. Comparison of data analysis methods. Maejo International Journal of Science and Technology, 6: 505 - 513.
[54] Yadav, A. K. (2015). Composition and medicinal properties of camel milk: A review. Asian Journal of Dairy and Food Research, 34(2): 83-91.