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Effects of some fruits on the processing and composition of camel milk ice cream

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ABSTRACT

The present study was conducted to process and evaluate the chemical composition of ice cream made from camel milk, flavored with vanilla, baobab and papaya fruits. Camel milk, baobab and papaya were examined for chemical composition before the processing. Ice cream samples were made using one level of vanilla (3%) as control and two levels of each baobab and papaya (3% and 5%). Then ice cream samples were packed into plastic cups and stored in a freezer at -18 °C for 8 weeks. The chemical composition was examined every two weeks. The data showed significantly ($P<0.05$) higher total solids and ash in baobab (5%) ice cream samples, while high fat content was found in vanilla (3%) and papaya (5%). Also, high protein content was found in papaya ice cream samples. It was concluded that processing of ice cream using baobab (3%) and papaya (3%) gives ice cream with good chemical properties. The study recommended processing of ice cream from camel milk adding baobab and papaya fruits. Further studies should be conducted by adding local fruits and other additives to enhance the chemical properties of ice cream from camel milk as functional food.

Introduction

The camel population in Sudan was estimated at 4.8 million heads according to the Ministry of Animal Resources and Fisheries (MOARF, 2016) and this number places Sudan as the second in numbers of camel population in the world after Somalia. However, the consumption of camel milk is limited among urban settlers, because camels are mainly kept in the desert arid areas of the country (El Zubeir and Nour, 2006; Musa et al., 2006; Suliman and El Zubeir, 2014; El Zubeir, 2015). For nomadic communities in particular, camel milk represents the main source of proteins, especially during their migration (Musa et al., 2006; Dowelmadina et al., 2015).

The dairy products from camels are rare at the commercial scale (Al Haj and Al Kanhal, 2010; El Zubeir, 2015). However, the ice cream from camel milk was produced successfully (Abu-Lehia et al., 1989; Ahmed and El Zubeir, 2015a,b; Ali and El Zubeir, 2020).

Flavor compounds added to ice creams are either natural or added as flavor extracts and mixtures (Michael et al., 2005). Moreover, the utilization of natural additives in the processing of ice cream, instead of industrial chemical color and flavor additives, could be a potential health risk to consumers (Penman et al., 2006). However, the usage of gum arabic as a stabilizer and honey as sweetener for ice cream would strengthen the nutritional and health benefits of camel milk as functional food (Ahmed and El Zubeir, 2015b).

One of the benefits of adding fruit juice to ice cream is to reduce using commercially available flavoring and coloring agents (Michael et al., 2005). The dry baobab (*Adansonia digitata*) fruit pulp is a rich source of carbohydrates, calcium and potassium and vitamins including thiamine, nicotinic acid and vitamin C (Decaluwe and Van, 2010). Ali and El Zubeir (2020) concluded that adding baobab and

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papaya fruits (3%) for making ice cream from camel milk improves its organoleptic properties.
Ripe papaya fruit is used in jam, jelly, nectar, juice, frozen slices, mixed beverages, ice-cream, powder, baby food and other concentrated and candied food (Saran and Choudhary, 2013). Similarly, Roy et al. (2015) reported that the ripe papaya fruit is consumed fresh for dessert and in fruit salad or as processed. Ahmed and El Zubeir (2020) concluded that the addition of papaya pulp improved processing properties and the chemical constituents of camel milk yoghurt. Ali and El Zubeir (2020) recommended the use of papaya as additive in camel milk ice cream in order to enhance the use of natural ingredients.
The successful processing of ice cream from camel milk indicated the possibility of using camel milk to produce special ice cream, which will fulfill the requirements of the functional food (Ahmed and El Zubeir, 2015a). Moreover, Ahmed and El Zubeir (2015a) recommended further studies when it comes to the utilization of natural indigenous fruits for processing camel milk ice cream for their nutritional and health value and nice flavor. Hence, this study was designed to process and evaluate chemical composition of ice cream from camel milk using natural flavors of vanilla, baobab and papaya fruits.

Materials and methods

The experimental procedures were done during the period from December 2016 to February 2017 at the Department of Dairy Production, Faculty of Animal Productiona and Department of Food Science and Technology, Faculty of Agriculture, University of Khartoum.

Source of materials

Twenty litters of fresh raw whole camel milk were brought from camels' farm in Khartoum North. Baobab and papaya were obtained from Central market of Khartoum. Vanilla powder was obtained from local market of Khartoum North.

Ice cream mix

Preparation of ice cream mix was done as described by Ahmed and El Zubeir (2015b). The camel milk was first heated at 72 ºC for 15 seconds, followed by the addition of the fruits, Gum arabic and cream while homogenizing the mix. Five portions of ice cream mix were put in the refrigerator at 5 ºC, and then each fruit was added to a mix. Each mix was placed into ice cream machine to process ice cream samples flavored with vanilla (3%) or baobab (3% and 5%) or papaya (3% and 5%). The packaging was done into plastic cups (size 60 grams) that were stored at -18 ºC in a freezer for eight weeks.

Chemical analysis of milk, baobab, papaya and ice cream

The chemical tests (total solids, fat, protein and ash) were performed in duplicates at the Department of Dairy Production, Faculty of Animal Production, University of Khartoum every 2 weeks.

Milk analysis

The Lactoscan (Milkotronic LTD, Europe) was used for camel milk analysis before processing the ice cream according to the manufacture' instructor. The analysis of compositional content of baobab and papaya fruits was performed as described in AOAC (2003).

Chemical analysis of ice cream

The fat content of ice cream samples was determined by the Gerber method and the protein was determined by using Kjeldahl method (AOAC, 2003). Similarly, the determination of total solids and the ash was done according to AOAC (2003).

Statistical analysis

This experiment was designed by factorial experiment 2X2. The data were analyzed using SPSS (version 21). Significant differences between means were determined at $P \leq 0.05$ and separated by DUNCAN.

Results

Compositional content of baobab and papaya and camel milk

Camel milk ice cream was processed by incorporation of baobab and papaya fruits in addition to vanilla as a control in the present study in order to assess its chemical composition.
The means for dry matter, fat, crude protein, crude fiber and ash of baobab were found as 88.75%, 0.3%, 2.98%, 7.75% and 5.25%, respectively, and the means of papaya fruits revealed 12.01%, 0.38%, 5.17%, 2.66% and 1.97%, respectively (Table 1). The analysis of camel milk revealed 10.99% solids non-fat, 5.43% fat, 4.38% protein, 5.97% lactose and 1.09% ash (Table 1).

The chemical content of camel milk ice cream

Total solids

Significant (P<0.05) differences were found in the total solids content of camel milk ice cream flavored with vanilla, baobab (3%), baobab (5%), papaya (3%) and papaya (5%). The ice cream flavored with 5% baobab revealed the highest mean of total solids (34.80% ± 0.37) in comparison with other types of ice cream samples. The values of total solid content of vanilla, papaya (3%) and papaya (5%) flavored ice cream were 31.53% ± 1.63, 31.29% ± 0.50 and 31.49% ± 0.65, respectively (Table 2).

The total solids of ice cream from camel milk showed significant (P<0.05) variations during the storage period, with the highest average, which was obtained in week 6 (32.86% ± 1.15). However, the lower means were found in day 1 and week 2 (31.95% ± 1.49), as shown in Table 3 and Figure 1.

Table 1. The chemical composition of baobab and papaya

Ingredients	DM (%)	Fat (%)	CP (%)	CF (%)	Ash (%)
Baobab	88.75	0.3	2.98	7.75	5.25
Papaya	12.01	0.38	5.17	2.66	1.97

Table 2. Chemical composition of ice cream made from camel milk using vanilla, baobab and papaya

Treatment	Fat (%)	Total solids (%)	Protein (%)	Ash (%)
Vanilla ice cream	3.06±0.83^{a}	31.53±1.63^{c}	2.23±0.31^{c}	0.47±0.09^{d}
Baobab (3%) ice cram	1.75±0.92^{c}	32.42±0.62^{b}	2.21±0.79^{c}	0.85±0.05^{b}
Baobab (5%) ice cream	1.85±1.10^{c}	34.80±0.37^{a}	2.62±0.91^{b}	0.98±0.14^{a}
Papaya (3%) ice cream	2.60±0.02^{b}	31.29±0.50^{a}	2.71±0.53^{b}	0.68±0.99^{c}
Papaya (5%) ice cream	3.20±0.42^{a}	31.49±0.65^{c}	3.07±0.82^{a}	0.72±0.06^{c}
L.S	***	***	***	***

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

Table 3. The effect of storage period on the chemical composition of ice cream made from camel milk

Storage period	Chemical composition			
	Total solids (%)	Fat (%)	Protein (%)	Ash (%)
Day 1	31.95±1.49^{b}	1.90±0.87^{c}	2.49±0.47^{b}	0.71±0.20^{b}
Week 2	31.95±1.49^{b}	1.90±0.87^{c}	2.39±0.47^{b}	0.71±0.20^{b}
Week 4	32.52±1.07^{ab}	2.58±1.04^{b}	2.5890 ±0.80^{b}	0.79±0.21^{a}
Week 6	32.86±1.15^{a}	2.50±0.52^{b}	1.96±0.44^{c}	0.69±0.19^{b}
Week 8	32.24±2.39^{ab}	3.58±0.44^{a}	3.51±0.59^{a}	0.81±0.16^{a}
L.S	**	***	***	**

Means bearing similar superscripts letters in the same column are not significantly different (P>0.05)
**= P<0.01
***= P<0.001

Fat content

The fat content of camel milk ice cream revealed significant (P<0.05) variation among the different flavors used (Table 2). The highest fat content was found in vanilla and papaya (5%) ice cream (3.06% ± 0.83 and 3.20% ± 0.42, respectively). Also, the fat content of the different types of ice cream revealed significant (P<0.05) differences during the storage period. Moreover, the highest average of fat content of ice cream samples was found in week 8 (3.58% ± 0.44) and the lowest value (1.90% ± 0.87) was found during day 1 and week 2 of the storage period (Table 3 and Figure 2).

Protein content

The protein content of the different ice cream flavors showed significant (P<0.05) differences (Table 2). Papaya (5%) ice cream showed the highest protein content (3.07% ± 0.82), while vanilla and baobab (3%) flavored ice cream samples recorded the lowest content of protein (2.23 ± 0.31 and 2.21 ± 0.79, respectively).

The protein content of the different types of ice cream showed significant (P<0.05) variations during the storage (Table 3 and Figure 3). The samples examined during week 8 showed the highest average (3.51% ± 0.59), while those examined at week 6 revealed the lowest protein content in ice cream samples (1.96% ± 0.44).

Ash content

Significant (P<0.05) differences in the content of ash were reported for the different flavored (vanilla, baobab and papaya) ice cream samples (Table 2). The highest mean of ash of camel milk ice cream was obtained for 5% baobab (0.98% ± 0.14). On the other hand, ice cream flavored with vanilla showed the lowest ash content (0.47% ± 0.09).

During the storage period, the ash content was significantly (P<0.05) different for the different flavored ice cream samples (Table 3). The highest average of ash content was found in ice cream examined at week 4 and 8 (0.79% ± 0.12 and 0.81% ± 0.16, respectively).

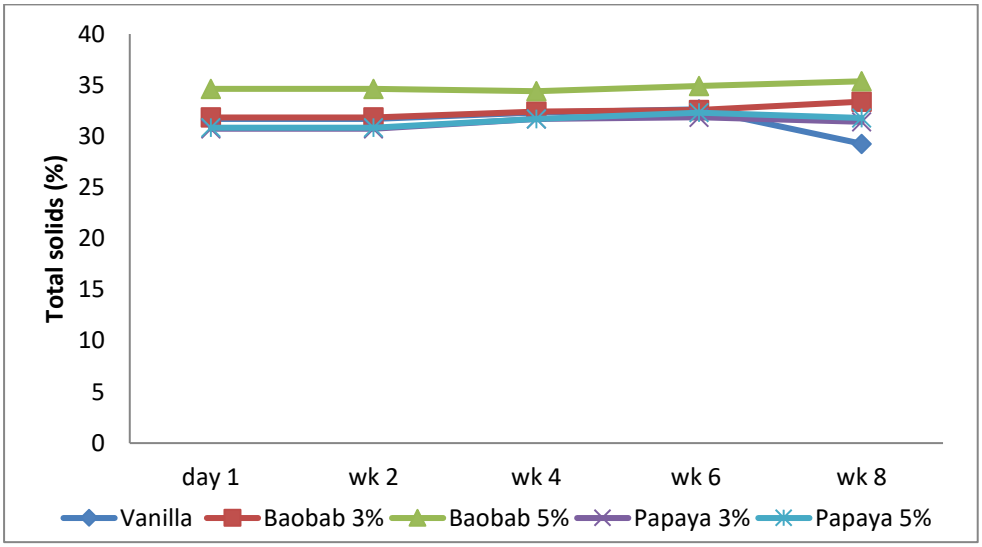

Figure 1. Composition of total solids content of vanilla, baobab and papaya ice cream samples made from camel milk during storage

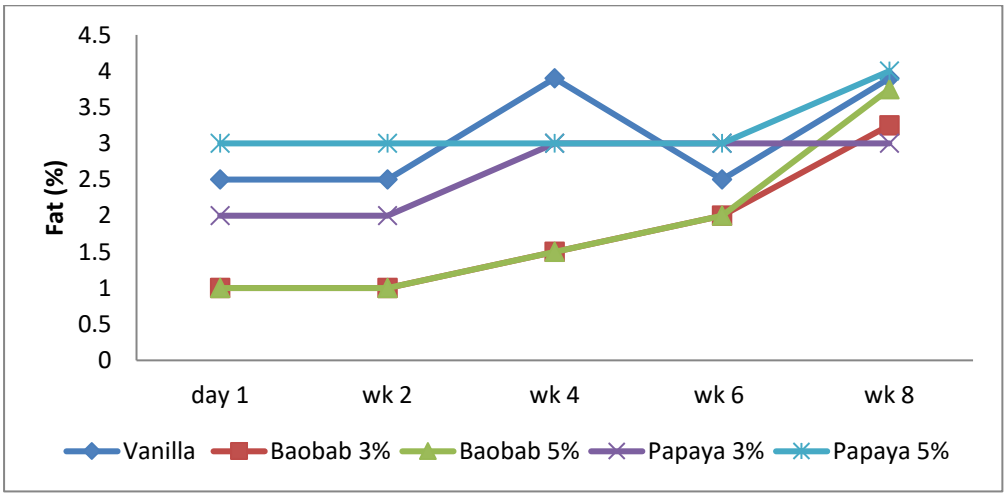

Figure 2. Composition of fat content of vanilla, baobab and papaya ice cream samples made from camel milk during storage

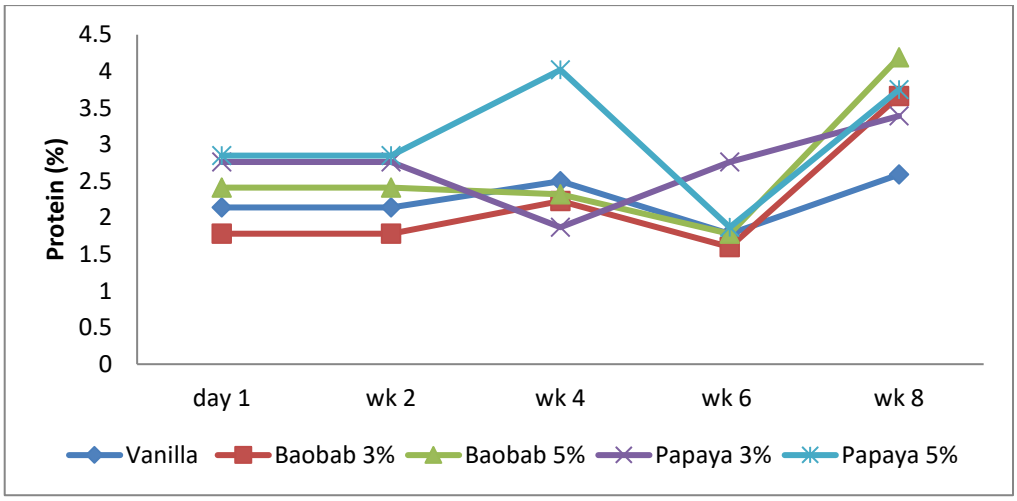

Figure 3. Composition of protein content of vanilla, baobab and papaya ice cream samples made from camel milk during storage

Discussion

The present results found for camel milk composition support those found by Shueip et al. (2008); El Zubeir and Ibrahium (2009); Al Haj and Al Kanhal (2010); Dowelmadina et al. (2014); Ibrahem and El Zubeir (2016).

Table 1 showed the chemical composition of baobab and papaya. This study was in line with findings mentioned for baobab (Decaluwe and Van, 2010; Cissé et al., 2013). They found the DM, fat, CP, CF and ash were 88%, 0.5%, 0.3%, 25.25% and 5%, respectively. According to Magdi (2004), baobab fruit pulp contains high amount of carbohydrate (76.2%) and crude fiber (5.4%), while having low protein (8.2%) and fat (0.3%). On the other hand , Roy et al. (2015) and Matter et al. (2016) reported 12.36% DM, 0.36% fat, 0.58% protein and 0.64% ash for papaya.

Higher values were obtained for the total solids and ash contents in baobab (5%) ice cream samples compared to vanilla and papaya (3%) ice cream samples (Table 3 and Figure 1 and Figure 4). This could be attributed to the high total solids and ash contents of baobab as shown in Table 1. The present result was consistent with the findings of Ahmed and El Zubeir (2015b); El Owni and Khater (2011), who reported that the mean of total solids was 33.41% ± 2.87. Also Mohammed and El Zubeir (2019) reported the average of total solids as 34.7%. Donhowe et al. (1991) found lower total solids in ice cream containing larger ice crystals. However, adequate total solids content is important for obtaining a good product with a smooth texture and firm body (Marshall and Arbuckle, 1996). The ash in the present result was consistent with the findings of Khater and El Owni (2009), who reported 0.64%±0.19 for the ash of ice cream. Similarly, Mohammed and El Zubeir (2019) found that the ash was 1.1%. This might be due to the high fiber content of baobab as shown in Table 1, which is supported by Cissé et al. (2013).

Table 2 showed a significant ($P<0.05$) variation in the fat content of camel milk ice cream using vanilla, baobab and papaya. Moreover, papaya ice cream showed higher fat content compared to other types of ice cream (Table 2 and Figure 2). This result is supported by Ahmed and El Zubeir (2015b), who found that the average of fat was 3.91%. Ice cream showed high levels of milk fat (10-16 %), moreover, it is a source of high quality energy and protein (Temiz and Yesilsu, 2010). The lowest mean for fat content was reported for baobab ice cream samples. This could mainly be due to the lower fat content of baobab (Table 1). Similarly, Eke et al. (2013) reported low fat content for baobab fruit pulp.

Camel milk ice cream flavored with vanilla, baobab and papaya showed significant ($P<0.05$) variations for protein content (Table 2). Papaya (5%) showed the highest average of protein. This might be due to the fact that ice cream has higher quantity and quality of protein compared to milk due to baobab and papaya fruits, which are very rich in protein (Gebauer et al., 2002). Also, Dev and Iqbal (2015) reported that papaya contains high amount of protien. Moreover, Arbuckle (1966) reported that the sources of proteins in ice cream include milk and stabilizers. Ahmed and El Zubeir (2015b) found higher protein content for camel milk ice cream. High quality and quantity of protein content was reported for ice cream, which is very palatable source of milk proteins (Arbuckle, 1966), which will satisfy the situations needing urgent energy supply especially for babies, children and sportsmen (Sengul and Ertugay, 2005).

On the other hand, baobab is of multipurpose, for food, beverage and medicine and the European Commission has recently authorized the import of baobab fruit pulp as a novel food as it reduces micronutrient deficiency (Buchmann et al., 2012). Moreover, due to the high protein content, low fat content and high value of metabolizeable energy, baobab fruit pulp is an excellent source of food (Eke et al., 2013).

Conclusions

This study concluded that different fruits affected significantly ($P<0.05$) the chemical composition of camel milk ice cream. The obtained values for the total solids and ash were higher for baobab (5%) ice cream samples, while the samples of vanilla and papaya (5%) ice cream were high in fat. The higher means of protein were obtained in papaya (5%) ice cream. This study recommended processing of ice cream adding baobab and papaya fruits. Further studies should be conducted by adding local fruits and other additives to enhance the chemical properties and to give good flavors ice cream utilizing camel milk.

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