

Study Properties of Fermented Camels' and Goats' Milk Beverages Fortified with Date Palm (*Phoenix dactylifera L.*)

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Abstract

Camels' milk (CM) and goats' milk (GM) are rich in nutrients and vitamins necessary for the health of humans and have therapeutic properties as they are rich in antioxidants and have a protective role against free radicals that have harmful effects on human health. Date palm (DP), camels' milk and goats' milk have been reported to be used for the prevention and treatment of various diseases in Arab countries. This study was designed to mix date palm with camels' milk and goats'. Eight formulations of both camels' milk and goats' were made from different percentages of date palm. These formulations were added at ratios of 0 (control), 10%, 20% and 30% (w/v) to camels' milk and goats' and the effect of this date palm on the composition and texture properties of the fermented obtained products were followed. It has been found that pH, protein, fat decreased and total solid, carbohydrate, ash, viscosity, vitamins, minerals and antioxidants increased with the increase of the added percentage of date palm compared to control. Microbial counts of the fermented camels' milk (FCM) and goats' milk (FGM) increased significantly ($P < 0.05$) with the addition of different formulations and during storage. Also, fermented camels' milk (FCM) and fermented goats' milk (FGM) fortified with different ratios date palm (DP) concentration resulted in good properties and higher acceptable sensory values (at a rate of 10% - 20%) in fresh and till the end of storage periods. The addition of the date palm to all treatments improved the composition, viscosity, microbiological quality of fermented camels' and goats' milk with nutritional functional values and acceptable sensory attributes.

Keywords

Fermented Camel Milk, Fermented Goat Milk, Date Palm, Synbiotic-Vitamins, Antioxidants, Organoleptic Properties

1. Introduction

Camels' milk (CM) ingredients are excellent for nutritional. It contains high levels of volatile acids, especially linoleic acids and polyunsaturated acids [1] and [2]. It also contains high concentrations of potassium, magnesium, zinc, copper, sodium, iron and Vitamin C, B [3]. CM produces a soft and easily digestible curd in the gastrointestinal tract as a result of contains a higher whey protein to casein ration compared to bovine milk [4]. There are medicinal values and experimental results indicate that camel milk has antiallergic, antidiabetic and antimicrobial properties [5] and [6].

Goats' milk (GM) has played a vital role in nutrition and health. For its beneficial and therapeutic effects on the people who have cow milk allergy. GM contains 25% more vitamin B6, 47% more vitamin A and 13% more calcium than cow's milk. Moreover, GM is also used as therapy against different problems including gastrointestinal disturbances and respiratory problems [7]. Also, the soft curd of GM may be an advantage for adult humans suffering from gastrointestinal disturbances [8]. The chemical characteristics of GM can be used to manufacture a wide variety of products, including fluid beverage products and UHT milk, fermented products such as cheese, buttermilk or yogurt, frozen products and butter.

Date may be considered as an almost ideal food, providing a wide range of essential nutrients and potential health benefits. It contains a high percentage of carbohydrate (total sugars, 44% - 88%), fat (0.2% - 0.5%), protein (2.3% - 5.6%) contains 23 types of amino acids and a high percentage of dietary fiber (6.4% - 11.5%). There are at least 15 minerals that vary from 0.1 to 916 mg/100g date, potassium can be found at a concentration of 0.9% in the flesh. Dates contain elemental fluorine that is useful to protect teeth against decay. Selenium, another elements believed to help prevent cancer and important in immune function. Dates contain at least six vitamins including a small amount of vitamin C, and vitamins B₁ thiamine, B₂ riboflavin, nicotinic acid (niacin) and vitamin A [9]. Many date varieties have a low glycemic index, its great potential as a medicinal food for a number of diseases inflicting human beings [10].

Currently, fermented milk is the most common commercial functional beverage and it has nutritional and Therapeutic properties. it contains probiotics with their positive effects on health when consumed regularly according to WHO recommendations also adding date palm as prebiotics as enhancers of human natural micro-flora.

The aim of this study is to produce a novel fermented milk beverage by a combination of camel or goat milk and date palm, its role in the effect on the vitality and numbers of probiotic to manufacture therapeutic fermented milk and their influence as prebiotic enhancers.

2. Materials and Methods

2.1. Materials

Fresh raw camels' (CM) and goats' milk (GM) used in this study were collected

from camel's and goat's milk herd belongs to Desert Research Center at North Western Coastal area, Matrouh, Governorate, Egypt. Milk were immediately maintained and stored under refrigerated conditions until the transferring it to the laboratory. Carboxy methyl cellulose (CMC) (used as a stabilizer) was obtained from Danisco Ingredients (Copenhagen, Denmark) by Misr Food Additives Company (MIFAD), Egypt. Probiotic cultures ABT-5 provided by the Chr. Hansen Laboratory Copenhagen, Denmark, contains the following species: *Lactobacillus acidophilus*, *Bifidobacterium bifidum* and *Streptococcus thermophilus* were used in the fermentation process. Freeze-dried bacterial starters were prepared separately as mother cultures in autoclaved (121°C/10 min) fresh buffaloes' skim milk (0.1% fat and 9.5% SNF) using a 0.02% (w/v) inoculums. The cultures were incubated at 42°C for Yo-Fast 1 starter and 39°C for ABT-5 starter, until curdling of milk. Culture was prepared 24 h before use. Date palm fruit (*Phoenix dactylifera L.*) was obtained from the local market, Egypt, and DPPH (2,2-diphenyl-1-picrylhydrazyl radical) was obtained from Sigma-Aldrich, Germany.

2.2. Methods

2.2.1. Preparation of Date Puree or Paste (DP)

Date fruits were washed under running water to remove dust and microscopic contaminants, seeds were removed manually and blended using electric blender after that heated at 85°C for 15 min. The prepared DP was kept in suitable containers in a deep freezer until use [11].

2.2.2. Fermentation of Camels' and Goats' Milk with Date Palm

The chemical composition of raw camels', goats' milk, and date palm (CM, GM, and DP, respectively) used in the manufacture of fermented beverages were shown in **Table 1**. Date palm was added to both of camels' and goats' milk at a ratio 10%, 20%, and 30%. Each portion manually blended and individually divided into 8 portions. The first and second portions were considered as a control (plain) sample and another 6 portions subjected to add date palm at a ratio 10%, 20%, and 30%. The CM and GM with a ratios DP were homogenized at 55°C - 60°C for 2 min using high speed mixer (30,000 rpm/min⁻¹) (X 520, UAC 30-R, Chicago II 6064). CMC was added to each CM and GM with DP at the ratio of 0.2% (w/v), heated in a water bath at 85°C for 30 min. Each of milk was cooled to 39°C for inoculation with 10⁸ - 10⁹ cfu/mL of ABT-5 mother cultures. The different treatments were dispensed into 100 ml bottles, incubated to ~4 h for ABT-5 culture, then immediately cooled at 5°C ± 1°C and stored at 5°C ± 1°C for 12 days.

2.2.3. Samples

All treatments were subjected to physicochemical, rheological properties microbiological analysis and organoleptic properties at fresh, 6 and 12 days of storage periods at 5°C ± 1°C.

Table 1. Physicochemical composition of camels', goats' milk and date palm.

Constituents	Camels' milk	Goats' milk	Date palm
Total solids (T.S) %	12.52 ± 1.05	13.23 ± 1.05	80.22 ± 0.10
Fat %	3.82 ± 0.10	4.20 ± 0.05	0.15 ± 0.05
Protein %	3.56 ± 0.15	3.66 ± 0.10	2.5 ± 0.05
Carbohydrate* %	4.32 ± 0.10	4.60 ± 0.10	75.67 ± 0.05
Ash %	0.82 ± 0.10	0.77 ± 0.10	1.9 ± 0.05
PH value	6.70 ± 0.05	6.60 ± 0.05	ND
Acidity %	0.133 ± 0.05	0.180 ± 0.05	ND
Total antioxidant activity** (DPPH) %	ND***	ND	69.50
Fiber	ND	ND	8.73

Mean of triplicate determination ± SD. *: Calculated by difference - TC% = [100 - (protein + ash + fat + moisture)]. **: Reduction percent reduction of antioxidant activity of DPPH. DPPH: 2,2 diphenyl-1-picrichydrazyl. *** ND: not determined.

2.2.4. Analytical Methods

1) Physicochemical composition

Total solids (TS), total nitrogen (protein), fat, fiber and ash contents; as well as pH values (using pH meter, Hanna instruments Italy Srl) and titratable acidity were determined in camels', goats' milk and different fermented beverages according to the methods of [12]. Total carbohydrates were also calculated by the difference for all samples analyzed, according to [13]. Antioxidant activity was determined according to [14]. Vitamin A contents was determined as given in [15]. Vitamins B complex were determined according to the method described by [16]. Potassium, Magnesium, Iron and Zinc concentration were determined by atomic absorption (Thermo-Tarrell, Ash, Smith-Hieftje (1000) in their digested solutions according to [17].

2) Rheological properties

The viscometer was operated between 10 and 50 rpm and shear stress, shear rate, viscosity data were obtained directly from the instrument, the SC4-21 spindle was selected for the measurement. Rheological measurements were determined for all treatments [18].

3) Microbiological examination

Samples of all treatment were prepared for microbiological examination according to the method described in the Standard Methods for the Examination of Dairy Products. Viable cells counts of *Str. Thermophilus*, *Lb. acidophilus* and *Bifidobacterium* sp. were enumerated using M17 agar, MRS-salicin agar and MRS agar media, respectively after the incubation at 37°C for 72 h. as in [19]. The count was expressed as colony forming units (cfu)/g of product.

4) Organoleptic properties

Fermented camels' and goats' milk samples used for beverages fortified with date palm were evaluated during storage for, flavour, appearance, acidity, and body & texture by 10 qualified panelists of staff members of Food Technology

Research Institute (FTRI) Agric. Research Center (ARC). Giza, Egypt. Results were recorded in a score sheet described by [20].

5) Statistical analysis

All experiments were conducted in triplicates by means of Analysis of variance (ANOVA) with Statistical Analysis System. Duncan's Multiple Range test was used when significant (at $P < 0.05$) mean comparison was performed, according to statistical analyses system user's guide [21].

The composition of dairy ingredients used is presented in **Table 1**.

3. Results and Discussion

3.1. Physicochemical Analysis

Data present in **Table 2** shows the chemical composition of both fermented camels' milk (FCM) and fermented goats' milk (FGM) used in this study. It could be noticed that total solids, carbohydrate, protein, fat and viscosity in FGM are higher than FCM. Some of these components such as total solids, carbohydrates and viscosity increased by the increase of the ratio of added date palm (DP). But protein and fat decreased by the addition of DP in both FCM and FGM. While FCM with DP showed the lowest value of total protein, fat. It has been showed significant differences ($P < 0.05$) between control fermented (CM, GM) milk without DP. These results are in agreement with those reported by [22]. Also FCM with DP showed the highest value of ash, which is due to the high content of ash in camels' milk. The levels of antioxidant activity % are presented in **Table 2**. These results indicated that addition of 10%, 20% and 30% of DP significantly ($P < 0.05$) increased the levels of antioxidant activity % in the various samples of

Table 2. Physicochemical analysis of fermented camels' milk (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP).

Product Property	Control		Treatments with ratio of date palm (DP)					
	FCM*	FGM**	Fermented camels' milk (FCM)			Fermented goats' milk (FGM)		
			10	20	30	10	20	30
Total solids %	15.10 ^A ± 0.14	15.60 ^A ± 0.08	15.25 ^A ± 0.10	15.30 ^A ± 0.10	15.39 ^A ± 0.10	15.79 ^A ± 0.08	15.82 ^A ± 0.08	15.89 ^A ± 0.08
Protein % (Nx6.38)	3.96 ^A ± 0.03	4.36 ^A ± 0.02	3.72 ^B ± 0.03	3.60 ^C ± 0.04	3.50 ^D ± 0.05	3.90 ^B ± 0.02	3.80 ^C ± 0.03	3.75 ^D ± 0.04
Fat %	3.75 ^A ± 0.04	3.90 ^A ± 0.04	3.60 ^B ± 0.03	3.55 ^C ± 0.03	3.48 ^D ± 0.03	3.85 ^B ± 0.04	3.75 ^C ± 0.04	3.65 ^D ± 0.04
Carbohydrate %***	6.53 ^D ± 0.06	6.52 ^D ± 0.03	6.89 ^C ± 0.03	7.09 ^B ± 0.02	7.32 ^A ± 0.02	7.09 ^B ± 0.01	7.29 ^B ± 0.01	7.48 ^A ± 0.01
Ash%	0.86 ^A ± 0.01	0.82 ^A ± 0.01	1.04 ^A ± 0.01	1.06 ^A ± 0.01	1.09 ^A ± 0.01	0.95 ^A ± 0.01	0.98 ^A ± 0.01	1.01 ^A ± 0.01
Antioxidant activity**** (DPPH) %	68.97 ^C ± 0.58	64.56 ^D ± 1.02	75.29 ^B ± 2.60	77.84 ^{AB} ± 1.28	80.15 ^A ± 0.38	73.14 ^C ± 0.55	75.10 ^B ± 1.09	79.90 ^A ± 0.44
Dynamic viscosity (P)	2.44 ^D ± 0.02	2.53 ^D ± 0.01	3.39 ^C ± 0.03	4.22 ^B ± 0.02	4.85 ^A ± 0.01	3.90 ^C ± 0.03	4.73 ^B ± 0.02	5.36 ^A ± 0.01

A, B, C and D: The means with the same letter among the treatments respectively are did not significantly different ($P < 0.05$). (FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. ***: Calculated by difference - TC% = [100 - (protein + ash + fat + moisture)]. ****Reduction percentage of antioxidant activity of DPPH DPPH: 2,2 diphenyl-1-picrichydrazyl. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

FCM and FGM as compared with control samples. Regarding antioxidant activity %, 30% both of FCM and FGM had the highest values (80.15% and 79.90%) in samples. Similar to our date, [23] revealed that adding 1% - 5% of date powder increased DPPH radical scavenging activity in yoghurt samples. This observed effect might be explained by its high content of phenolics and antioxidants [24]. Hence, due to its high content of bioactive components, DP has several beneficial effects related to oxidative stress, anemia, cancer and diabetes.

The changes in pH values of all treatment during storage period are presented in **Figure 1**. The pH values decreased gradually in all treatments, which reflect the development of acidity due to the growth and activity of the starter culture, and also by increasing ratio of added DP compared with the control. The pH values of both FCM and FGM with added DP ratios 10%, 20% and 30% were significantly different ($P < 0.05$) compared with control. These results are in agreement with those [22] and [25] mention that the acidity is increased by increasing the concentration of the added DP.

Table 3 shows the percentage of vitamin A (Retinol) and vitamin B complex contents for all treatments. The results showed that FCM contained lower levels of vitamins B1, B2, B6, B9, and B12. However, concentration of vitamin A was relatively higher. The results agree with those obtained by [6]. Vitamins A, B1, B2, B6, B9 and B12 increased in FCM and FGM with added DP and all vitamins increased by the increase of the ratio of added DP.

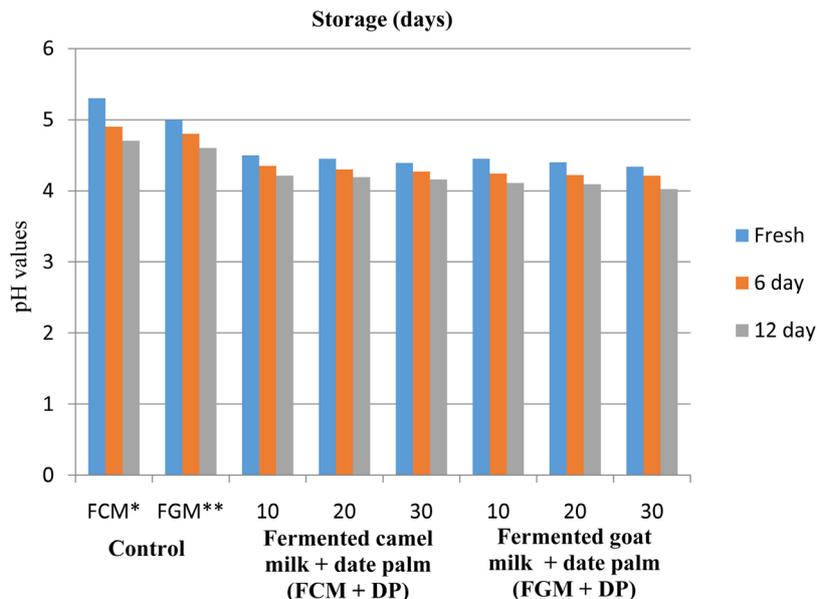


Figure 1. Changes in pH values of fermented camels' (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP) during storage at $5^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 12 days. (FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

Table 3. Vitamins content (mg/100g) of fermented camels' milk (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP).

Vitamins content (mg/100g)	Treatments with ratio of date palm (DP)							
	Control		Fermented camels' milk (FCM)			Fermented goats' milk (FGM)		
	FCM*	FGM**	10	20	30	10	20	30
Retinol (Vitamin A)	96.97	96.95	99.01	100.01	120.05	98.99	99.97	119.90
Thiamine (Vitamin B1)	29.50	29.45	31.09	33.10	36.30	31.05	33.50	36.20
Riboflavin (Vitamin B2)	17.01	16.90	18.20	20.10	30.10	18.01	19.99	29.09
Pyridoxine (Vitamin B6)	0.16	0.15	0.18	0.20	0.22	0.17	0.20	0.22
Folic (Vitamin B9)	9.25	9.22	9.27	9.29	9.30	9.23	9.25	9.26
Cobalamin (Vitamin B12)	10.75	10.65	10.99	11.20	11.80	10.85	11.10	11.68

(FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

The total amount of minerals content in the fermented beverages produced from CM or GM with DP are given in **Table 4**. From these data, it could be noticed the highest level of potassium, magnesium, iron and zinc in FCM compared to FGM. The minerals increased by the increase of the ratio of added DP. These results are in agreement with those reported by [26] [27].

3.2. Microbiological Analysis

Data showed in **Table 5** illustrate the *Str. thermophilus*, *Lb. acidophilus*, *Bifido* bacteria and total bacterial count in (log CFU/g) of FCM and FGM as affected by adding DP during storage. It could be noticed from the results that they increased by the increase of the ratio of added DP compared with the control in all treatments, *Str. thermophilus* and *Lb. acidophilus* counts increased gradually in all treatments up to 6 days of storage and then decreased, *B. bifidum* counts decreased gradually in all treatments up to the end of storage period. The addition of DP improved the viability of *Str. thermophilus*, *Lb. acidophilus* and *B. bifidum*, it could be noticed from all treatments that this bacteria decreased with the progress of storage periods and can be attributed to the presence of soluble dietary fiber, these results agree with those by [22] [28] and [29]. It could be noticed from the results that the total bacterial counts of control and all treatments supplemented with DP had increased up to 6 days and then decreased with progressing storage periods. Also, it could be noticed the lowest total of bacterial count after 6 days in all treatments.

3.3. Organoleptic Properties

The organoleptic properties of the FCM and FGM with DP of the ratio 10% revealed high acceptability for flavour, body, textures, appearance and acidity in comparison to control as shown in **Table 6**. The addition DP caused a significant

Table 4. Mineral contents (mg/100g) of fermented camels' milk (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP).

Mineral contents (mg/100g)	Control		Treatments with ratio of date palm (DP)					
	FCM*	FGM**	Fermented camels' milk (FCM)			Fermented goats' milk (FGM)		
			10	20	30	10	20	30
Potassium (K)	1225.51	692.62	1352.38	1630.99	1828.83	711.71	722.35	750.94
Magnesium (Mg)	9.70	6.87	9.77	9.83	9.90	6.92	7.01	7.10
Iron (Fe)	3.90	2.53	4.16	5.52	6.69	2.82	3.13	3.90
Zinc (Zn)	1.90	1.13	2.34	2.40	2.90	1.16	1.23	1.60

(FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

Table 5. Microbiological analysis of fermented camels' milk (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP) during storage at 5°C ± 1°C for 12 days.

Treatments bacterial starter strains	Storage (days)	Control		Treatments with ratio of date palm (DP)					
		FCM*	FGM**	Fermented camels' milk (FCM)			Fermented goats' milk (FGM)		
				10	20	30	10	20	30
ABT-5 <i>Str.</i> <i>Thermophilus</i> (cfu*** × 10 ⁶ /g) count	Fresh	7.3 ^{Bb} ± 0.04	8.5 ^{Aa} ± 0.07	7.5 ^{Ba} ± 0.17	7.8 ^{Aa} ± 0.20	8.1 ^{Aa} ± 0.18	8.8 ^{Aa} ± 0.14	9.0 ^{Aa} ± 0.19	9.3 ^{Aa} ± 0.20
	6	7.5 ^{Bb} ± 0.01	8.6 ^{Aa} ± 0.03	7.7 ^{ABa} ± 0.22	8.0 ^{Aa} ± 0.14	7.7 ^{Aa} ± 0.16	8.9 ^{Aa} ± 0.24	8.7 ^{Aa} ± 0.27	9.2 ^{Aa} ± 0.25
	12	6.9 ^{Bb} ± 0.07	8.1 ^{Aa} ± 0.07	7.1 ^{Bb} ± 0.16	6.8 ^{Bc} ± 0.13	6.5 ^{Cd} ± 0.18	7.9 ^{Ab} ± 0.17	7.5 ^{Bb} ± 0.13	8.5 ^{Aa} ± 0.20
<i>Lb. acidophilus</i> (cfu × 10 ⁶ /g) count	Fresh	6.9 ^{Bb} ± 0.09	7.5 ^{Aa} ± 0.04	7.1 ^{Bb} ± 0.14	7.5 ^{Aa} ± 0.22	7.8 ^{Aa} ± 0.16	7.7 ^{Aa} ± 0.15	8.1 ^{Aa} ± 0.25	8.6 ^{Aa} ± 0.28
	6	7.0 ^{Bd} ± 0.11	7.4 ^{ABb} ± 0.04	7.2 ^{Bc} ± 0.11	7.6 ^{Aa} ± 0.16	8.0 ^{Aa} ± 0.20	7.9 ^{Aa} ± 0.21	8.0 ^{Aa} ± 0.18	8.2 ^{Aa} ± 0.20
	12	6.5 ^{Cd} ± 0.08	7.1 ^{Bb} ± 0.04	6.6 ^{Bc} ± 0.18	7.0 ^{Bb} ± 0.12	7.4 ^{Aa} ± 0.19	7.5 ^{Aa} ± 0.16	7.6 ^{Aa} ± 0.20	7.8 ^{Aa} ± 0.22
Bifidobacteria (cfu × 10 ⁶ /g) count	Fresh	6.9 ^{Aa} ± 0.03	7.1 ^{Aa} ± 0.04	7.2 ^{Aa} ± 0.20	7.5 ^{Aa} ± 0.17	7.9 ^{Aa} ± 0.13	7.3 ^{Aa} ± 0.18	7.5 ^{Aa} ± 0.12	7.9 ^{Aa} ± 0.10
	6	6.5 ^{Cc} ± 0.03	6.8 ^{Bb} ± 0.06	6.8 ^{Bb} ± 0.19	7.0 ^{Aa} ± 0.16	7.5 ^{Aa} ± 0.22	7.0 ^{Aa} ± 0.17	7.1 ^{Aa} ± 0.18	7.5 ^{Aa} ± 0.20
	12	6.1 ^{Cd} ± 0.03	6.3 ^{Cd} ± 0.07	6.5 ^{Bc} ± 0.15	6.6 ^{Bc} ± 0.19	7.2 ^{Aa} ± 0.21	6.5 ^{Bc} ± 0.16	6.8 ^{Bb} ± 0.20	7.0 ^{Aa} ± 0.22
Total bacterial count	Fresh	6.28 ^{Bb} ± 1.04	6.52 ^{Aa} ± 0.59	6.50 ^{Aa} ± 1.04	6.66 ^{Aa} ± 1.04	6.80 ^{Aa} ± 0.21	6.69 ^{Aa} ± 0.59	6.79 ^{Aa} ± 1.04	6.81 ^{Aa} ± 0.19
	6	6.37 ^{Bc} ± 1.16	6.42 ^{Bb} ± 0.67	6.61 ^{Bb} ± 1.16	6.70 ^{Aa} ± 1.16	6.87 ^{Aa} ± 0.79	6.62 ^{Aa} ± 0.67	6.73 ^{Aa} ± 1.16	6.88 ^{Aa} ± 0.57
	12	6.17 ^{Cd} ± 0.60	6.24 ^{Cc} ± 0.90	6.30 ^{Bc} ± 0.60	6.38 ^{Bb} ± 0.60	6.48 ^{Bb} ± 0.90	6.40 ^{Aa} ± 0.10	6.51 ^{Aa} ± 0.76	6.64 ^{Aa} ± 0.74

a, b, c & d and A,B,C and D: The means with the same letter among the storage period and treatments respectively are did not significantly different (P < 0.05). (FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

Table 6. Organoleptic properties of fermented camels' milk (FCM) and fermented goats' milk (FGM) beverages fortified with date palm (DP) during storage at 5°C ± 1°C for 12 days.

Organoleptic properties	Storage (days)	Control		Treatments with ratio of date palm (DP)					
		FCM*	FGM**	Fermented camels' milk (FCM)			Fermented goats' milk (FGM)		
				10	20	30	10	20	30
Flavour (45)	Fresh	43 ^{ABa} ± 0.05	43 ^{ABa} ± 0.04	44 ^{Aa} ± 0.02	44 ^{Aa} ± 0.03	43 ^{Aa} ± 0.07	44 ^{Aa} ± 0.05	42 ^{ABa} ± 0.04	40 ^{Ba} ± 0.05
	6	42 ^{ABab} ± 0.01	42 ^{ABab} ± 0.02	43 ^{Aa} ± 0.05	43 ^{Aab} ± 0.01	42 ^{Aab} ± 0.03	44 ^{Aa} ± 0.02	41 ^{Ba} ± 0.04	38 ^{Cbc} ± 0.06
	12	41 ^{ABb} ± 0.03	41 ^{ABb} ± 0.03	42 ^{Aa} ± 0.02	42 ^{Ab} ± 0.01	41 ^{Ab} ± 0.04	43 ^{Aa} ± 0.03	40 ^{Ba} ± 0.05	37 ^{Cc} ± 0.04

Continued

Body and texture (35)	Fresh	33 ^{Aa} ± 0.04	33 ^{Aa} ± 0.07	34 ^{Aa} ± 0.02	34 ^{Aa} ± 0.03	33 ^{Aa} ± 0.05	34 ^{Aa} ± 0.06	32 ^{ABa} ± 0.03	30 ^{Ba} ± 0.07
	6	33 ^{ABa} ± 0.07	33 ^{ABa} ± 0.03	34 ^{Aa} ± 0.08	34 ^{Aa} ± 0.07	32 ^{Ba} ± 0.04	33 ^{Aa} ± 0.03	32 ^{Aa} ± 0.10	30 ^{Ba} ± 0.08
	12	32 ^{ABa} ± 0.04	32 ^{ABa} ± 0.03	34 ^{Aa} ± 0.05	34 ^{Aa} ± 0.01	32 ^{Ba} ± 0.05	33 ^{Aa} ± 0.03	31 ^{Ba} ± 0.02	30 ^{Ba} ± 0.04
Appearance (10)	Fresh	9 ^{Aa} ± 0.07	9 ^{Aa} ± 0.04	9 ^{Aa} ± 0.03	9 ^{Aa} ± 0.09	8 ^{Aa} ± 0.05	9 ^{Aa} ± 0.04	8 ^{ABa} ± 0.07	7 ^{Ba} ± 0.05
	6	9 ^{Aa} ± 0.08	9 ^{Aa} ± 0.04	9 ^{Aa} ± 0.10	9 ^{Aa} ± 0.03	7 ^{Aa} ± 0.06	9 ^{Aa} ± 0.02	8 ^{ABa} ± 0.08	7 ^{Ba} ± 0.05
	12	8 ^{ABa} ± 0.10	8 ^{ABa} ± 0.04	9 ^{Aa} ± 0.05	9 ^{Aa} ± 0.08	7 ^{Aa} ± 0.04	9 ^{Aa} ± 0.03	8 ^{ABa} ± 0.04	7 ^{Ba} ± 0.02
Acidity (10)	Fresh	9 ^{Aa} ± 0.04	9 ^{Aa} ± 0.07	9 ^{Aa} ± 0.05	9 ^{Aa} ± 0.03	8 ^{Aa} ± 0.09	9 ^{Aa} ± 0.06	8 ^{ABa} ± 0.04	7 ^{Ba} ± 0.02
	6	8 ^{Aab} ± 0.03	8 ^{Aab} ± 0.02	9 ^{Aa} ± 0.03	8 ^{Aab} ± 0.05	7 ^{Aa} ± 0.04	8 ^{Aab} ± 0.08	8 ^{Aa} ± 0.07	6 ^{Bab} ± 0.05
	12	7 ^{Ab} ± 0.06	7 ^{Ab} ± 0.05	8 ^{Aa} ± 0.04	7 ^{Ab} ± 0.06	7 ^{Aa} ± 0.02	7 ^{Ab} ± 0.03	7 ^{Aa} ± 0.01	5 ^{Bb} ± 0.05
Total (100)	Fresh	94 ^{Ba} ± 0.04	94 ^{Ba} ± 0.05	96 ^{Aa} ± 0.04	96 ^{ABa} ± 0.04	92 ^{Ca} ± 0.03	96 ^{Aa} ± 0.03	90 ^{Ca} ± 0.04	84 ^{Da} ± 0.05
	6	92 ^{Bb} ± 0.06	92 ^{Bb} ± 0.08	95 ^{Aa} ± 0.03	94 ^{Ab} ± 0.05	88 ^{Cc} ± 0.04	94 ^{Ab} ± 0.05	89 ^{Ca} ± 0.07	80 ^{Db} ± 0.05
	12	89 ^{Bc} ± 0.09	89 ^{Bc} ± 0.05	93 ^{Ab} ± 0.02	92 ^{Ac} ± 0.03	87 ^{Cc} ± 0.08	92 ^{Ac} ± 0.06	86 ^{Cb} ± 0.04	79 ^{Db} ± 0.03

a, b, c & d and A,B,C and D: The means with the same letter among the storage period and treatments respectively are did not significantly different ($P < 0.05$). (FCM)*: Fermented camels' milk. (FGM)**: Fermented goats' milk. (Control): Fermented camels' milk (FCM), Fermented goats' milk (FGM) + zero% date palm (DP). 10: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 10% date palm (DP). 20: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 20% date palm (DP). 30: Fermented camels' milk (FCM), Fermented goats' milk (FGM) + 30% date palm (DP).

increase ($P < 0.05$) flavour scores compared to the control during storage. These results agreed with that of [30] and [31]. Addition of DP to FCM and FGM significantly ($P < 0.05$) affected the body and texture of the product. Samples with 10% showed the significant ($P < 0.05$) highest body and textures scores compared to 20% and 30% DP of the added to FCM and FGM. Variations were found for the overall acceptability scores of FCM and FGM. Added DP to FCM and FGM was associated with higher score for acceptability in flavour, body& texture, appearance and acidity compared with control had the lowest acceptability.

4. Conclusion

Camels' and goats' milk could meet a big part of the daily needs of humans from these nutrients because camels' and goats' milk has most of the essential nutrients. The present study increased the knowledge about the camels', goats' milk and date palm. Also, it could be concluded that fermented camel milk and goat milk fortified with date palm can be considered as a good source of vitamins, minerals and characterized by a higher ratio of antioxidants activity, especially with date palm. On the other hand, the addition of 10% and 20% improved the organoleptic properties of fermented camels' milk and fermented goats' milk until the end of the storage period. The overall results showed that it is possible to produce fermented camels' milk or fermented goats' milk with flavour, body & texture and good appearance by adding dates.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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