Production and Characteristics of Camel Milk

Conference Paper · November 2016

CITATIONS
0

READS
2,785

2 authors:

Atakan Koç
Aydın Adnan Menderes University
40 PUBLICATIONS **202** CITATIONS
SEE PROFILE

S. Atasever
Ondokuz Mayıs Üniversitesi
67 PUBLICATIONS **274** CITATIONS
SEE PROFILE

Production and Characteristics of Camel Milk

Atakan KOÇ[1] Savaş ATASEVER[2]

[1] Prof.Dr., Adnan Menderes University., Faculty of Agric., Dept. Anim. Sci., 09100, Aydın/TURKEY
e-mail: akoc@adu.edu.tr
[2]Assoc.Prof.Dr., Ondokuz Mayıs University, Faculty of Agric., Dept. Anim. Sci., Samsun/TURKEY
e-mail: satasev@omu.edu.tr

Abstract

Camel is a multipurpose animal used for economic and social aspects. During the last five decades, by increasing about 4.43 folds, world camel milk production reached to 2.8 m tons. In addition to be a good source of Vit-C, Ca and K, all essential nutrients found in bovine milk also exist in camel milk. Due to smaller fat globules, creaming capacity of camel milk is poorer than that of bovine milk and also camel milk fat melting point is higher than those of bovine, sheep, goat and buffalo milk fat. Camel milk has also potential in the treatment of series of diseases. Camel milk has a lack of β-lactoglobulin and can be used to cure food-born allergies. In conclusion, especially in the regions where other livestock are failure to be thrived, camel milk is the main source of animal origin food, but in other regions its social and therapeutic roles become prominent.

Key words: Camel milk, milk quality, milk constituents, therapeutic effect

Deve Sütü Üretimi ve Özellikleri

Özet

Deve ekonomik ve sosyal bakış açılarından değerlendirilecek çok amaçlı bir hayvandır. Son 50 yıllık süreçte, 4.43 kat artarak, dünya deve sütü üretimi 2.8 m ton düzeyine ulaşmıştır. Vit-C, Ca ve K bakımından iyi bir kaynak olmasına ilave olarak, sığır sütünde bulunan tüm temel besin maddeleri aynı zamanda deve sütünde de mevcuttur. Daha küçük yağ küreciklerinden dolayı, deve sütünün kremaj kapasitesi sığır sütünden daha düşüktür ve aynı zamanda deve sütü yağının erime noktası sığır, koyun, keçi ve manda sütü yağınınkinden daha yüksektir. Deve sütü aynı zamanda birçok hastalığın tedavisinde de bir potansiyele de sahiptir. Deve sütünde β-laktaglobulin bulunmaz ve gıda kaynaklı alerjilerin tedavisinde kullanılabilir. Sonuç olarak, özellikle diğer çiftlik hayvanlarının başarılı olarak yetiştirilemediği bölgelerde, deve sütü en önemli hayvansal kaynaklı gıda kaynağıdır, ama diğer bölgelerde sosyal ve tedavi edici rolleri öne çıkmaktadır.

Anahtar kelimeler: Deve sütü, süt kalitesi, süt bileşenleri, tedavi edici etki

Introduction

Camel is a multipurpose animal used for economic and also social purposes (Abokor, 1987). Besides being used for transportation, it is used for milk and meat production, wool, hair and hides, and also used in entertainment, celebration and competition (Al-Juboori, 2016). Due to be a good source for animal origin food, the value of camel become important in the places where the traditional other livestock production, agricultural activity, hunting and gathering resources are very limited such as in refugees in the Sahrawi in the north-west Africa and also a cultural heritage for some societies (Volpato and Howard, 2014). Due to be usually reared on isolated rangelands with poor infrastructure, compared to other livestock species, Camelids result in less environmental damage (Raziq et al., 2010). However, some fundamental changes have been occurred in camel husbandry due to losing its traditional function as a means of transport, warfare and non-monetary exchange with the use of fossil fuels and motor vehicles, increasing reliance on purchased fodder and other inputs rather than the resources benefited from deserts (Volpato and Howard, 2014).

In addition, for racing and wrestling purposes, because of being placed high social value to the owner, people in the pastoral society and also in affluent society in some parts of the world aspire to have camel to have a respectable position and wealth in the society.

Camel is first domesticated in the Arabian Sahara about 6000-5000 years ago (Şenel, 2009; Çalışkan, 2010) and is known as the ship of the desert. According to FAO (2013) statistics world camel population is 27.01 million heads and 44 countries raised camel. The countries having more than 1 million camel populations are Somalia (7.1 m), Sudan (4.8 m), Kenya (3.1 m), Niger (1.7 m), Chad (1.5 m), Mauritania (1.5) and Pakistan (1.0 m). As seen in Figure 1, the number of camels raised in the world is doubled in the last 50 years and depending on this increase, the milk and meat (524,390 tons) production also increased.

Turkey is one of the countries raising camel. After a sharp decrease in the population from 65,000 heads in 1961 to 811 heads in 2005, an increase is noticed in the population since 2005 because of the popularity of camel wrestling in the country and also cultural tourism and pack animal in nomadic Yoruk Turks migration in Turkey (Yilmaz and Ertugrul, 2014). As a result of that the number reached to 1,543 heads in 2015 (Figure 2). In Turkey, the main aim of raising camel is camel wrestling porpoises. Camel wrestling

is very popular in the south-west part or Turkey from December to the end of March (Çalışkan, 2010). Camel wrestling is also organized in Afghanistan and Pakistan, but in these countries camels were wrestled without packsaddle (Yilmaz and Ertuğrul, 2015). It was reported that camel wrestling had been organized in 87 residential areas on Sunday since 1987 (Çalışkan, 2010). As the start of camel wrestling is unknown, it was estimated that camels have been wrestling for about 4.000 years in the Middle Asian Turks (Çalışkan, 2010; Yilmaz et al., 2014).

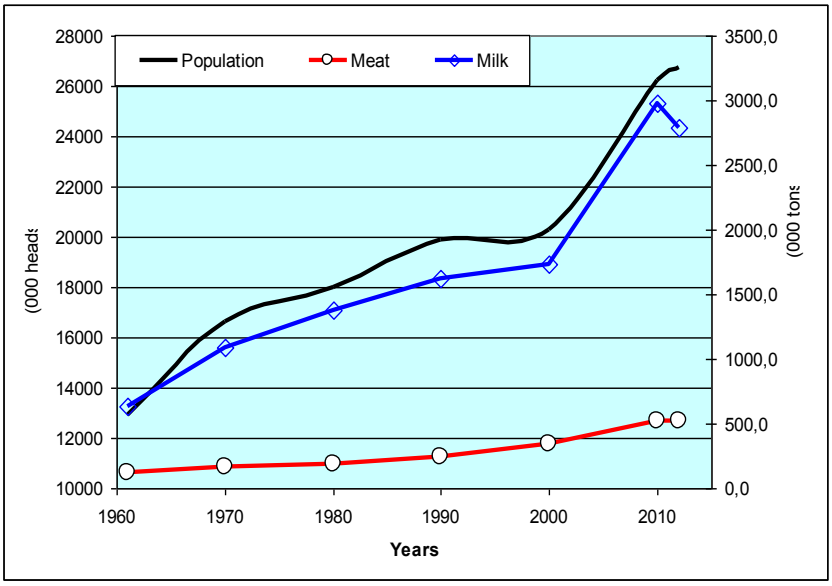

Figure 1. Changes of camel population, camel milk and meat production in the world.

The popularity of camel wrestling in Turkey encourages some producers to obtain and raise wrestling camel in the country instead of importing from Iran, Afghanistan or some other middle east countries. As a result of that, these camel farms have also opportunity to produce milk, especially for therapeutic purposes besides raising camels for wrestling. In this review, after discussing the camel milk production in the world, milk yield and milk constituents and also therapeutic effects of camel milk are discussed.

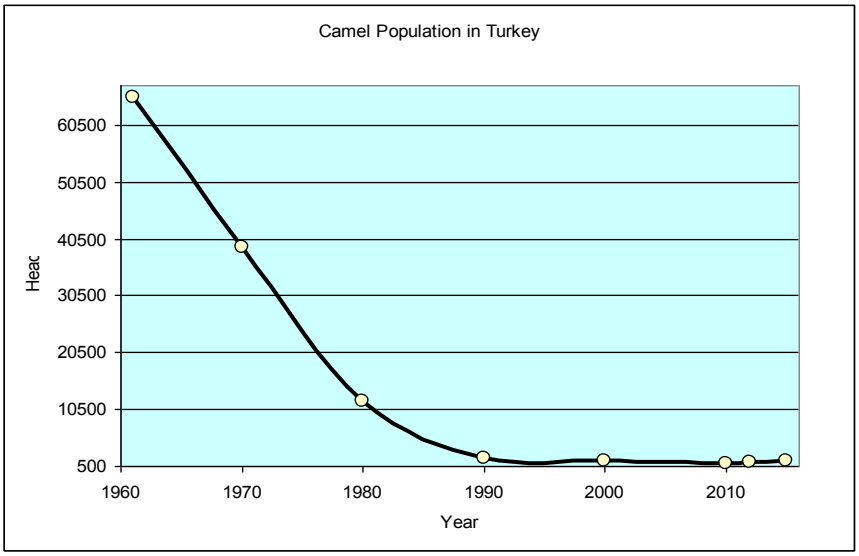

Figure 2. Changes of camel population in Turkey.

Materials and Methods

In this review, in addition to statistical data of FAO, 23 published paper, 3 books and 1 web sources were used. At first, statistical data were given about camel milk production in the world, then milk yield, milk constituents, amino acid, vitamin, mineral and fatty acid contents, microbial and somatic cell counts and also therapeutic effects of camel milk are discussed.

Results and Discussion

According to FAO Statistics (FAO, 2013) the world camel milk production in 2012 is 2.8 m tons and 93.01% of it (2.59 m tons) produced in Africa and 6.99% of produced in Asia (194.590 tons). In Europa, very small amount of camel milk and meat is produced, accounting for 70 tons and 134 tons, respectively. During the five decades, the world camel milk production has been increased for about 4.43 folds. The highest camel milk is produced in Somalia with 1.09 m tons and Kenya is following this country with 0.993 m ton. These two countries produce about 72.3% of the camel milk in the world.

It is known that about 83% of milk consumed by human is cow milk in the world and in Asia besides cow milk buffalo milk production is about 35% of the total production and to a lesser extent, sheep and goat milk produced. Depending on the low production quantities and also specific production regions in the world, the studies on yak, camel, mare and donkey milk are very limited.

Al-Juboori et al. (2013) reported that in United Arab Emirates camel milk has a significant socio-economic importance and is an important diet for human in the country and added that it is highly nutritious, suitable for human nutritional requirements and also a safe food for human baby consumption. Al-Juboori et al. (2013) also emphasized that camel milk is saltier that human and bovine milk.

Konuspayeva et al. (2009) reported that camel milk is a good source of proteins for humans living in the arid regions. Zhao et al. (2015) reviewed the literature and concluded that Bactrian camel milk can be considered as a good source of nutrients for human and added that all the essential nutrients found in bovine milk are also exist in the camel milk. Gassem et al. (2015) analyzed the camel milk chemically and reported that it is an excellent source of protein, fat and energy and added that due to its nutritional composition it is suggested to be able to be used as food, in functional food or in food formulation to combat the hunger during drought season in arid and semi-arid-land.

In China, camel milk is used for butter, cheese, milk tea, face mask, soap and etc and Bactrian camels in China is also used for working and wool production and their milk production was reported very scarce (Zhao et al., 2015). It was also stated camel milk creaming capacity is poorer than that of bovine milk due to smaller fat globules than that of bovine milk and added that both Bactrian and Dromedary camel milk fat has higher iodine index and melting point than those of bovine, sheep, goat and buffalo milk fat due to higher unsaturated fatty acids and long-chain saturated fatty acids (C14–C18) content than those of these species' milk (Zhao et al., 2015).

Camel milk yield

In a survey conducted in Somalia, Farah et al. (2007) reported that camel milk is consumed fresh or as fermented form and in the diet of pastoral community one of the main components and Vit-C sources are the camel milk and they added that in 12-18 months lactating periods, the daily milk yield of a camel varies from 3 kg to 10 kg.

The highest milk yield was seen in the third and fourth month of lactation and the milk production of Bactrian camel is lower than those of Dromedary camels (Zhao et al., 2015). In a study, the lactation length, total milk yield and 305-d milk yield of dromedary camel were reported 335±8 days (ranged from 193 to 467 days), 1041±51 kg (ranged from 335 to 2110 kg) and 926±36 kg (ranged from 357 to 1840 kg), respectively (Hermas, 1998). El-Hatmi et al. (2004) studied the quantity and the quality of milk from multiparous camel (Camelus dromedarius) grazed in arid pastures in the region of Medenine and with 4 kg concentrates fed camel produced higher milk from their two teats (3105.4 ± 1027.8 ml/day) than that of 1 kg concentrate fed group (1854 ± 386.9 ml/day).

Camel milk constituents

Semen and Altıntaş (2014) reported that as cattle, sheep, goat and buffalo colostrum contains immunoglobulin type IgG_1, IgG_2, IgA and IgM, in addition to these immunoglobulins, camel colostrum contains IgG_3. Zhao et al. (2015) reported that colostrum from camel is produced for the first 7 days of lactation and the titratable acidity and pH of Chinese Bactrian colostrum is similar to those of Dromedary camel colostrum. In the first milking, the lactose content of Bactrian colostrum is ranged from 4.38 to 4.59%, fat content is ranged from 0.27 to 0.35% and progressively increased to its average fat level in the first week, protein content is ranged from 14.23 to 18.93% and the total solids is ranged from 20.16 to 25.07% (Zhao et al., 2015).

Milk composition of some mammals are given in Table 1. Park and Haenlein (2006) declared that in fat, protein, lactose, ash and total solids in camel milk is 4.9%, 3.7%, 5.1%, 0.7% and 14.4%, respectively.

Table 1. Composition (%) of milk from some mammals (Park and Haenlein, 2006)

Species	Fat	Protein	Lactose	Ash	Total Solids
Ass (Donkey)	1.2	1.7	6.9	0.4	10.2
Horse	1.6	2.7	6.1	0.5	11.0
Buffalo (Egyptian)	7.7	4.3	4.7	0.8	17.5
Camel	**4.9**	**3.7**	**5.1**	**0.7**	**14.4**
Cow (Holstein)	3.5	3.1	4.9	0.7	12.2
Goat	3.5	3.1	4.6	0.8	12.1
Human	4.5	1.1	6.8	0.2	12.6
Sheep	5.3	5.5	4.6	0.9	16.3
Yak	7.0	5.2	4.6	?	16.8

Konuspayeva et al. (2009) reviewed camel milk components depending on geographical region (Table 2) and concluded that there were significant differences between breeds (or species), nutritional conditions, seasonal and also physiological conditions.

The fat, total protein, lactose and total dry matter contents of camel milk varies from 0.28% and 6.40%, from 2.15% to 4.90%, from 2.40% to 5.80% and from 8.64% to 16.05%, respectively and as seen in Table 3, under the similar farming conditions in Kazakhstan, fat, protein and total solids are higher, lactose content is lower in Bactrian camel milk than those of dromedary camel milk (Konuspayeva et al., 2009).

Table 2. Mean and standard deviation of camel milk components according to the geographical origin of 82 literature references (Konuspayeva et al., 2009)

Region	n	Fat	Total Protein	Total Solids	Lactose	Ash
Asia	11	5.07±0.21**	4.02±0.47**	13.86±1.97**	5.33±0.42*	0.79±0.10
East Africa	20	4.14±0.80*	3.33±0.52	12.69±1.11*	4.18±0.72	0.76±0.09
North Africa	16	3.50±1.01	3.21±0.60	12.53±1.22	4.65±0.67	0.84±0.08*
Indian subcontinent	12	3.49±0.85	3.36±0.64	12.05±1.61	4.45±0.74	0.78±0.07
Western Asia	17	3.31±1.03	3.10±0.62	11.62±1.29	4.45±0.40	0.78±0.05
Undetermined	6	3.62±0.81	3.34±0.53	12.22±1.22	4.49±0.77	0.72±0.07

Zhao et al. (2015) reviewed the total solids, protein, fat, lactose and ash content means in Bactrian and Dromedary camel milk were 14.54±0.84% and 12.33±1.51%, 3.93±0.44% and 3.27±0.65%, 5.34±0.60% and 3.52±0.74%, 4.51±0.69% and 4.57±0.85%, and 0.79±0.11% and 0.78±0.09%, respectively.

Table 3. Mean and standard deviation of camel milk components in Kazakhstan for Bactrian camel, dromedary and hybrids (Konuspayeva et al., 2009).

Species	n	Fat	Total Protein	Total Solids
Bactrian	56	6.67±2.93	3.33±0.74	13.07±1.15
Dromedary	70	5.94±2.26	3.03±0.76	12.39±0.74
Hybrids	20	6.09±1.81	3.28±1.01	11.91±0.74

Zhao et al. (2015) emphasized that in bovine milk the main components in whey proteins are β-lactoglobulin (52.6%) and α-lactalbumin (26.0%), however, in Bactrian camel milk, similar to Dromedary camel, the main and second whey protein components are α-lactalbumin (from 45.5 to 53.0%) and camel serum albumin (30% and 41.7%). The same researchers also declared that the heat stability of other two whey proteins (lactoferrin and immunoglobulin) in Bactrian camel milk is higher than those of bovine milk. Semen and Altıntaş (2015) stated that lactoferrin is a minor whey protein in cow milk however it is one of the major whey proteins in camel milk.

El-Hatmi et al. (2004) studied the quantity and the quality of milk from multiparous camel (Camelus dromedarius) grazed in arid pastures in the region of Medenine and reported the total solid contents and fat contents were 148.5 g/L and 55.6 g/L, respectively.

Al-Juboori et al. (2013) reported the moisture, protein, fat, lactose, ash and total solids for Dromedary camels are 88.96±1.222%, 3.71±0.16%, 2.21±0.16%, 3.36±0.25%, 0.48±0.05% and 11.26±0.69%, respectively.

Amino acids contents

For amino acids (aa) in camel milk, it was reported that the major aa in camel milk is glutamic acid and its level in Bactrian camel (ranged from 21.27 to 22.26 g/100 g protein) is similar to Dromedary camel, cow, sheep and goat milk, however, the levels of lysine (ranged from 7.65 to 7.81 g/100 g protein), proline (ranged from 7.62 to 9.59 g/100 g protein) and alanine (ranged from 2.35 to 2.68 g/100 g protein) in Chinese Bactrian camel milk are lower than those of Dromedary camel milk, but the level of histidine (ranged from 2.64 to 2.75 g/100 g protein) and arginine (ranged from 3.99 to 4.35 g/100 g protein) levels in Chinese Bactrian camel milk are similar to Dromedary camel milk, the level of methionine in Bactrian camel milk is higher than cow and human milk, but the cysteine level of it is very close to human milk (Zhao et al., 2015; Semen and Altintaş, 2015). The essential: non-essential aa ratio in Dromedary camel milk is 0.93, is very close to Bactrian milk (0.09-097), cow (1.0), sheep (0.95) and human (1.07) milk (Zhao et al., 2015).

Season conditions and the camel breeds are the main factors having effects on the camel milk protein content and similar to Dromedary camel milk, two main casein fractions homologous to bovine β-casein and αs1-casein were isolated from Bactrian camel milk (Zhao et al., 2015), however, compared with bovine milk (13-13.6%), there is very low content or absence of κ-casein in Bactrian camel milk, but was found in Dromedary camel milk. The second main protein component of camel milk is whey proteins and the proportion of whey protein in Chinese Bactrian Xinjiang milk (28.1%) is similar to Dromedary milk (28.5%), however in Chinese Bactrian milk, similar to Dromedary camel, one whey protein fraction homologous to β-lactoglobulin is deficient and because of that camel milk could be used to cure food-born allergies (Zhao et al., 2015).

Gassem et al. (2015) analyzed the camel milk for amino acid contents and revealed that, camel milk has high content of glutamic acid, proline, leucine, valine and aspartic acid.

Vitamin and mineral contents

Camel milk is also rich for Vit-C (Konuspayeva et al., 2009). Under the similar farming conditions in Kazakhstan, Vit-C, calcium and phosphorus contents are higher in Bactrian camel milk than those of Dromedary camel milk (Konuspayeva et al., 2009). Gassem et al. (2015) also reported that camel milk has substantial amount of Vit-C and low amount of B1 (thiamine) and B2 (riboflavin). Zhao et al. (2015) also reported that Vit-C in Bactrian camel (27.6–34.3 mg/L) is similar to Dromedary camel but Vit-C in camel milk is 3.6 times higher than that of bovine milk. However, Al Mutery et al. (2008) reported from the hand milked camel milk samples belong to 6 different Saudi Arabia camel breeds that Vit-C content of them were low. Zhao et al. (2015) reported that Vit-D level (640-692 IU/l) in Chinese Bactrian camel milk is higher than that of cow milk (20-30 IU/L).

Seman and Altıntaş (2014) declared that camel milk has higher amount of Vit-C and niacin (Vit-B_3) but, lower amount of thiamin (Vit-B_1), riboflavin (Vit-B_2), Pantotenik acid (Vit-B_5), cobalamin (Vit-B_{12}) and alpha-tocopherol (Vit-E) than those of cow milk.

Camel milk is also rich in Fe, Zn, Cu, K, Na, Ca (Al-Juboori et al., 2013). In Bactrian and Dromedary camel milk, Ca, P, Na, K and Mg contents are 146.8 ± 45.1 vs 123.7 ± 24.4 mg/100 mg, 134.1 ± 15.0 vs 85.2 ± 26.3 mg/100 mg, 61.5 ± 6.8 vs 51.6±15.7 mg/100mg, 167 ± 29.3 vs 143.5 ± 46.0 mg/100 mg and 9.9 ± 1.8 vs 12.6 ±4.1 mg/100 mg, respectively (Zhao et al., 2015). Due to human milk has less Ca and K content, camel milk could be used as a good source for these minerals (Zhao et al., 2015).

Al-Awadi and Srikumar (2001) reported that the concentration of manganese and iron in camel milk was remarkably higher (7-20-fold and 4-10-fold, respectively) than in human milk and cow milk and the zinc content of camel milk was higher than that of human milk but slightly lower than in cow milk, the concentration of copper in camel milk was similar to that of cow milk but lower than in human milk and added that about 50-80% of zinc, copper and manganese in camel milk were associated with the casein fraction, similar to that of cow milk. They also recommended that camel milk can be considered as a potential source of manganese, selenium and iron, perhaps not only for infants, but also for other groups suspected of mild deficiency of these elements.

Fatty acid contents

Fat content of camel milk consisting of unsaturated fatty acids, volatile fatty acids, mainly linoleic acid, makes it more digestible and cardiovascular friendly (Al-Juboori et al., 2013). Fatty acid composition (%) of camel, cow and human milk are given in Table 4.

Zhao et al. (2015) stated that the fatty acid composition of camel milk is affected by many factors like breed, feeding, seasonality, lactation stage, region, etc, and added that the predominant saturated fatty acids in Bactrian and Dromedary milk is C16:0, C18:0, and C14:0 and the mean of the even-number-saturated fatty acids from three Chinese Bactrian camel breeds milk was 59.03 ±2.14% and these means were reported very similar to Dromedary milk (55.45 ±4.15%), but higher than that of human milk (40.95 and 40.7%) and bovine milk (50.09 and 47.96%). Gassem et al. (2015) also reported that camel milk has a very low level of short chain fatty acid and with 26.55% palmitic acid, 24.25% oleic acid, 10.2% myristic acid and 9.98% palmitoleic acid. Semen and Altıntaş (2015) declared that camel milk contains palmitioleic acid (C16:1) more than the other species.

Table 4. Fatty acid composition (%) of camel, cow and human milk (Zhao et al., 2015).

	C12:0	C14:0	C15:0	C16:0	C18:0	C18:1	C18:2	C18:3
Bactrian	0.78-1.24	11.49-15.43	1.23-1.42	28.95-32.05	14.75-16.1	18.78-26.05	1.19-2.16	0.6-2.91
Dromedary	0.50-1.00	9.9-14.5	0.5-1.62	26.6-34.9	9.7-17.82	16.7-26.3	1.1-4.8	0.51-1.50
Bovine	1.6-3.1	4.09-10.4	1.25-2.44	26.6-34.21	7.86-10.19	22.69-29.0	2.25-3.20	0.36-1.1
Human	2.7-2.9	7.2-7.3	0	19.88-24.0	6.8-10.87	24.73-39.8	12.2-19.24	0.9-2.96

Microbial count and somatic cell count in milk

Microbial contamination of raw milk occurs from the infection of the udder, outside of the udder and surface of the equipment used milking and storage of milk. Gassem et al. (2015) in Saudi Arabia, reported that total aerobic plate count in camel milk was 1.4×10^5 per ml. Khandelwal et al. (2013) in India, Nagy et al. (2013) in Dubai reported the mean values of total viable count in camel milk were 7.67 log cfu/mL, and 5,157 log cfu/mL, respectively and Nagy et al. (2013) also reported about 4.0% of the samples were over $10x10^3$ cfu/mL. Al Mutery et al. (2008) analyzed the hand milked camel milk from 6 different Saudi Arabia camel breeds and the mean total plate count was reported to be $1.6x10^3$ cfu/mL. Omer and Eltinay (2008) investigated the raw camel milk microbiological quality in Sudan and found that the mean value of aerobic plate count was 1.8×10^5 cfu/mL.

Khedid et al. (2003) conducted a study on the determination of the microbiological quality of fresh camel milk in Morocco and concluded that the microbial profile of camel milk were relatively low and reported the standart plate count as 5×10^4 cfu/mL.

Semereab and Molla (2001) reported total aerobic plate count in Ethiopian camel as 2×10^4 cfu/mL and also mentioned the unhygienic milking techniques, use of unclean milking bowls and lack of cooling facilities in the region.

The mean coliform count in camel milk was also reported by Semereab and Molla (2001), Omer and Eltinay (2008), Khandelwal et al. (2013) and Gassem et al. (2015) as 3.5×10^3 cfu/mL, 6.8×10^1 cfu/mL, 4.201 log cfu/mL and $2.7x10^2$/ mL, respectively. Khedid et al. (2003) reported that coliforms were the most abundant microorganism in camle milk and added that coliform count ranged from 1 cfu/mL to $8x10^4$ cfu/mL.

Similar to other species like cattle and buffaloes, clinical and subclinical mastitis cause significant decreases in protein, fat, lactose and solid-nonfat in the milk of Dromedary camel and the result of the inflammatory response in the udder is increasing the neutrophil number and total somatic cell counts in the milk (Ali et al., 2016). In a study in Dubai, the mean somatic cell count (SCC) in the milk of Dromedaries are 394×10^3 cells/mL and about 14.6% samples for the SCC was higher than 500×10^3 and, SCC in camel milk is exceed the threshold level of bovine milk (Nagy et al. (2013). Al Mutery et al. (2008) analyzed the hand milked camel milk from 6 different Saudi Arabia camel breeds and the mean SCC was reported to be $1.4x10^4$ cells/mL.

Therapeutic Effects of Camel Milk

Mammals milk have valuable therapeutic properties as it contains a high concentration of anti-bacterial, anti-fungal, anti-viral and anti-parasitic compounds and these helps fight serious diseases like hepatitis, Rota viral diarrhea, tuberculosis, and schistosomiasis. Camel milk has also been used therapeutically against certain types of cancer, diabetes, colitis, autism and Crohn's disease and camel milk can be considered an option for individuals who intolerant to lactose and children allergic to cow milk (Al-Juboori et al., 2013). Due to anti-cancer and anti-diabetic properties in addition to high content of unsaturated fatty acids and low hypo-allergic effect due to low β-casein and the lack of β-lactoglobulin, camel milk is used for medicinal purposes (Konuspayeva et al., 2009).

Depending on the biologically active substances the fresh and fermented camel milk could provide particular potential therapeutic properties to the patients (Zhao et al., 2015). It could have a potential in the treatment of a series of diseases like dropsy, jaundice, tuberculosis, asthma, anemia, piles, gastrointestinal ulcers, type 1 diabetes and diarrhea-causing viruses. In the recent studies, fresh or fermented Chinese Bactrian camel milk had particular health benefits like inhibiting the growth of tumor, adjuvant treatment of diabetes, anti-fatigue and anti-inflammatory (Zhao et al., 2015). In order to study about the therapeutic properties of camel milk, some studies were conducted on mice and reported that camel milk had better effect on improving the index of thymus and spleen of immune-depressed mice, inhibiting the growth of tumor, enlarging the spleen index and thymus index, increasing the phagocytes rate of macrophages and phagocytic index (Zhao et al., 2015).

It was also stated that with consuming camel milk for about one year, the cellular immune response of chronic hepatitis B patients was enhanced and with consuming orally about 1000 mL camel milk, the parameters of urine for patients with kidney diseases were improved and in rats with chronic renal failure after treatments with consuming Bactrian camel milk for about 28 days, serum creatinine and blood urea nitrogen levels were decreased and serum SOD level increased (Zhao et al., 2015). A significant reduction in the dose of rosiglitazone maleates required to maintain long-term glycemia control for type-2 diabetes patients was also reported after drinking Bactrian milk (Zhao et al., 2015). It was also reported that as a model for humans in rats, Bactrian camel milk has a significant on adjunctive therapeutic efficacy for diabetes mellitus (Zhao et al., 2015). It

was also declared that in mice after treatment with feeding raw camel milk, an obvious effect was seen in prolonging the climbing pole length and swimming time, and after exercise, the decreases in the levels of blood lactic acid and blood urea nitrogen levels and increase in the reserves of liver glycogen are seen (Zhao et al., 2015). It should be stressed that the therapeutic properties of camel milk discussed above need to be confirmed with further studies.

Conclusion

Camel is a multipurpose animal used for economic and also social purposes and the value of camel become important in the places where the traditional other livestock production, agricultural activity, hunting and gathering resources are very limited. All the essential nutrients found in bovine milk also exist in the camel milk and camel milk is a good source of proteins for humans living especially in the arid regions. In Turkey, camel farms have opportunity to produce camel milk, especially for therapeutic purposes besides raising camels for wrestling. There are some differences in camel milk production and characteristics and those of the most produced bovine milk. These are differences in colostrum production period, whey protein components, κ-casein, methionine, glutamic acid, proline, leucine, valine, aspartic acid, Vit-C, Fe, Zn, Cu, K, Na, Ca, saturated fatty acids and so on.

Studies about camel milk yield and also its therapeutic roles would be beneficial, especially countries in which bovine, sheep and goat milk production are high. Due to low production level of camel milk, primarily in the countries where bovine, sheep and goat milk production are high, the importance should be given to the therapeutic roles of camel milk and also the therapeutic properties of camel milk worked in some studies also need to be confirmed with further studies.

References

1. Abokor A C. The camel in Somalia oral traditions. Somalia Academy of Sciences and Arts in Corporation with Scandinavian Societies of African Studies, 1987, Uppsala.
2. Al-Juboori AT, Mohammed M, Rashid J, Kurian J, El Refaey S. Nutritional and medicinal value of camel (*Camelus dromedarius*) milk. WIT Transact Ecol Environ 2013, 170: 221-232
3. Al-Juboori A. https://www.google.com.tr/?gfe_rd=cr&ei=mjI4V-X_DdPR8gf7kbvQCA&gws_rd=ssl#q=Reproduction_in_Camels_tcm95-44862. 2016.

4. Al-Mutery A, Wernery U, Jose Sh. Quality of raw camel milk from Saudi Arabia. J Camel Pract Res 2008, 15(1): 61-62.
5. Al-Awadi FM, Srikumar TS. Trace elements and their distribution in protein fractions of camel milk in comparison to other commonly consumed milks. J Dairy Res 2001, 68 (3):463-469.
6. Ali, F., Hussain, R., Qayyum, A., Gul, S.T., Iqbal., and Hassan, M.F. Milk Somatic Cell Counts and Some Hemato-Biochemical Changes in Sub-Clinical Mastitic Dromedary She-Camels (*Camelus dromedarius*). Pak Vet J 2016, 36(4): 405-408.
7. Çalışkan V. A Geography of Cultural Heritage: Camel Wrestling in Turkey. Pressed in ANKA Matbaacılık 2010, 2. Matbaacılar Sitesi 1ND3 Topkapı/ Istanbul / TURKEY.
8. El-Hatmi H, Khorchani T, Abdennebi M, Hammadi M, Attia H. Effects of diet supplementation on camel milk during the whole lactation under Tunisian arid range conditions. J Camel Pract Res 2004, 11(2): 147-152.
9. FAO. Food and Agriculture Organization of the United Nations 2013, http://faostat.fao.org/site/339/default.aspx (RT:15.05.2016)
10. Farah Z, Mollet M, Younan M, Dahir R. Short communication: Camel dairy in Somalia: Limiting factors and development potential. Livest Sci 2007, 110: 187–191.
11. Gassem M, Osman M, Rahman IA, Al-Assaf A, Alhazmy M. Chemical composition and microbial quality of sudanese camel milk. J Camel Prac Res 2015, 21 (2): 243-247.
12. Hermas SA. Genetic Improvement and the Future Role of the Camel in the Arab World: Problems and Opportunities. Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, United Arab Emirates Univ 1998, 2: 56-68.
13. Khandelwal D, Joshi H, Chaudhary BL. Microbial quality of camel milk in Udaipur (Raj.), India. Asian J Microbiol, Biotech Envir Scie 2013, 15(1): 177-179.
14. Khedid K, Faid M, Soulaimani M. Microbiological characterization of one humped camel milk in Morocco. J Camel Prac Res 2003, 10(2): 169-172.
15. Konuspayeva G, Lemarie E, Faye B, Loiseau G, Montet D. Fatty acid and cholesterol composition of camel's (Camelus bactrianus, Camelus dromedarius and hybrids) milk in Kazakhstan. J. Dairy Sci. Technol 2008, 88: 327–340.

16. Konuspayeva G, Faye B, Loiseau G. The composition of camel milk: A meta-analysis of the literature data. J Food Comp Anal 2009, 22: 95–101

17. Nagy P, Faye B, Marko O, Thomas S, Wernery U, Juhasz J. Microbiological quality and somatic cell count in bulk milk of Dromedary camels (*Camelus dromedaries)*: Descriptive statistics, correlations, and factors of variation. J Dairy Sci 2013, 96: 5625–5640.

18. Omer RH, Eltinay AH. Microbial quality of camel's raw milk in central and southern regions of United Arab Emirates. J Food Agric 2008, 20(1): 76-83.

19. Park, Y. W. and Haenlein, G.F.W. 2006. Handbook of milk of non-bovine mammals. Blackwell Publishing Professional 2121 State Avenue, Ames, Iowa 50014, USA

20. Raziq A, de Verdier K, Younas M. Ethnoveterinary treatments by dromedary camel herders in the Suleiman Mountainous Region in Pakistan: an observation and questionnaire study. J Ethnobiol Ethnomed 2010, 6:16

21. Semen, Z., Altıntaş, A. Biologi cal and Therapeuti c Effe cts of Dietary Camel Milk. Türk Veteriner Hekimleri Birliği Dergisi 2015: 3 - 4

22. Semereab T, Molla B. Bacteriological quality of raw milk of camel (*Camelus dromedarius*) in Afar region (Ethiopia). J Camel Prac Res 2001, 8(1): 51-54

23. Şenel A. History of Humanity from Rodentia to Leecher. 2nd Pres. Imge Bookstore Publications 2009. Konur Sok. No:17. Ankara/Turkey

24. Volpato G, Howard P. The material and cultural recovery of camels and camel husbandry among Sahrawi refugees of Western Sahara. Research, Policy Pract 2014, 4:7

25. Yilmaz O, Ertürk YE, Ertuğrul M. 4000 years history of camel wrestling from Middle Asia to Anatolia in Turks. COMU J Agric Fac 2014, 2 (1): 37–44.

26. Yilmaz O, Ertuğrul M. Camel wrestling culture in Turkey. Turk J Agric Natur Sci 2014, Special Issue (2): 1998-2005

27. Yilmaz O, Ertuğrul M. Camel wrestling or camel fighting? J Adnan Menderes Univ Agric Fac 2015, 12(2): 117-123.

28. Zhao DB, Bai YH, Niu YW. Composition and characteristics of Chinese Bactrian camel milk. Small Rumin Res 2015, 127: 58–67.