



Composition of Camel Milk: A Blessing for Health

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Abstract

Camel milk is very rich source of protein along with potential anti-microbial and protective activity. Water is among the important factors that severely affect the camel milk composition. Its contents in camel milk vary from 84-90 percent. Dehydrated camel has a most remarkable feature that it has the ability to maintain lactation with the milk secretion having over 90 percent water contents, which could be considered a natural adaptation in order to provide the necessary fluids to the calf. The relative amount of the fat, protein and lactose components of camel milk are very similar to those in the cow milk and the water contents affect the percentage of fat. Moreover, the fat present in the camel milk doesn't forms a layer so it is evenly distributed throughout the milk as small micelles that make its digestion easier. It contains higher concentration of long chain fatty acids so healthier enough. The pH and density of camel milk ranges between 6.5-6.7 with an average of 6.56 and 1.025-1.032 with an average of 1.029 and both values are lower than those of cow milk. The colostrum of camel is slightly diluted and clearly white like normal milk unlike bovines. Generally; colostrum transforms to milk within 7-10 days in camels. Camel milk has unique property to inhibit the growth of microorganisms as it contains protective proteins and enzymes with special antibacterial and antiviral properties such as lactoferrin, peptidoglycan protein and lacto-peroxidase. It also contains protective insulin to treat the Diabetes mellitus. This paper will describe the composition and health benefits of camel milk; thus, will be a useful addition in the field of camel science.

Keywords: Camel; Milk; Food; Desert; Pastoral

Introduction

Camel seems very important in many countries where used as food animal. Its ability to utilize rangeland in marginal areas and to survive and produce well under hot and harsh environment has been recognized greatly over the years [1]. Globally camel enjoys a very unique ecological and socioeconomic status [2]. It has been giving services to the humans under highly marginalized ecosystems and very harsh climatic conditions since ancient times [3]. The camel has numerous unique capabilities and characteristics as that it can be ridden, loaded with baggage, milked, eaten, traded for goods, harnessed to plough and used for other agricultural operations and exhibited in the zoo [4,5]. Camel plays a pivotal role in the subsistence pastoral economy in the diverse eco-zones [6]. Due to

its appearance and ability to survive in hot, harsh arid environment and to tolerate many stresses, e.g. heat, scarcity of feed and water; camel has fascinated mankind [7]. The camel can digest dry matter and crude fiber better than other ruminants. This dry matter and high fiber digestibility might be attributed to the longer retention time of large particles in its fore stomach and unique movement of the fore stomach of the camels [8]. The dromedary is the most important among the domestic animals in the hot, arid and semi-arid regions as it has potential to produce higher quality foods like milk and meat under extremely harsh weather at comparatively lower costs [9]. It has great tolerance to higher temperatures, solar radiation and water scarcity. It can thrive well on sandy deserts

with poor vegetation and mainly consume those feed materials which is unutilized by several other domestic animals [10].

Milk composition is dependent on various factors like species, breeds, nutritional status, management, parity, age, physiological status and season, etc. Milk composition as well as quality severely altered by many factors such as genetic, physiological (age, body weight, stage of lactation), milking methods and management [11]. The milk composition is mainly affected by the stage of lactation [12]. It changes all over the year, milk fat and total solids were found to be significantly higher in early lactated and non-pregnant females as compared to late lactated and pregnant she-camels [13].

Milk Composition

Composition of camel milk greatly varies from the milk of other large and small ruminants. Kappeler S, et al. 1998 [14] reported the camel milk composition as fat 3.8%, protein 2.7-4.7%, calcium 1000-1400 mg/ml, phosphorus 0.650-1.10 mg/L, iron 0.3-0.8 mg/L. Four fractions of casein in camel's milk have been isolated, that casein particles range from 20-300 nm in diameter. Their amino acids composition has similarities to the α 1, α 2, β and γ casein, respectively, as of cow's milk. The fat contents of camel milk vary from 2.5-5.9 % having a mean of 4.6 %, lactose contents from 4.8-5.8 % which are slightly higher than those of cow's milk, minerals in term of ash from 0.6-0.8 % and protein is 2.8 %. Literature revealed that fat and protein percentages in camel's milk ranged between 2.4-5.5% and 2.5-4.5%, respectively. Mean values for fat and protein percentages were reported to be 3.57 ± 0.09 and 2.85 ± 0.036 , respectively in Pakistani camels [15]. [16] reported fat and protein percentages as 2.63% and 4.01%, respectively in Kohi camels in Balochistan. Elamin FM and Wilcox [17] reported 3.15% fat and 2.81% protein in milk of Majaheim camel in Saudi Arabia. Reported fat and protein percentages were 3.22% and 2.91% in Majaheim, 2.85% and 2.52% in Hamra and 2.46% and 2.36% in Wadah camel's milk, respectively in Saudi Arabia [18]. Camel's milk was found to be less fatty than that of cow's milk so it is readily digested [19]. Reported percent fat, protein, SNF, lactose, ash and water were to be 5.5, 4.5, 8.9, 3.4, 0.9 and 85.6, respectively in Ethiopian camels [20].

Yagil R and Etzion Z [21] reported the milk composition of camel as 4.3, 4.6, 14.3, 4.6, 1.01 and 85.7 percent fat, SNF, protein, lactose, ash and water, respectively while 1.1, 2.5, 8.8, 2.9, 0.96 and 91.2 percent fat, protein, SNF, lactose, ash and water, respectively in dehydrated camels. It is evident that when camels are exposed to drought conditions (seasonal water shortage), for the provision of fluid to the calf there is a physiological mechanism of change in the water content of milk. [22,23] reported the camel milk fat, protein, SNF, total solids and casein contents as 4.2 ± 1 , 3.0 ± 0.6 , 8.7 ± 1.6 , 12.8 ± 1.6 and 2.4 ± 0.5 percent, respectively in the Errer valley. Guliye AY, et al. [24] reported the milk composition for Bedouin camels as 2.79, 3.39, 4.81, 0.77 and 11.5 percent protein, fat, lactose, ash and total solids, respectively. [25] studied physico-

chemical quality of camel milk and reported range for total solids, solids not fat, fat, protein, casein, lactose and ash as 7.76-12.13, 5.56-8.29, 1.8-5, 1.8-3.2, 0.78-2.76, 2.9-4.12 and 0.85-1 gm/100 gm. [26] Summarized 82 reports and reported the average camel milk composition as 3.82 ± 1.08 , 4.46 ± 1.03 , 3.35 ± 0.62 , 0.79 ± 0.09 and 12.47 ± 1.53 for fat, lactose, total protein, ash and total solids, respectively. [27] Studied milk yield and characteristics of Tunisian camel and reported average total solids, fat, lactose, ash and total protein concentration as 116.76 ± 11.32 , 35.67 ± 7.61 , 43.82 ± 5.68 , 8.21 ± 0.64 and 29.45 ± 3.29 gm/L, respectively. [28] Studied milk production of dromedary camels under intensive management in United Arab Emirates and reported average fat, protein, lactose, total solids and solids-not-fat (SNF) concentrations as 2.51 ± 0.03 , 2.60 ± 0.01 , 4.03 ± 0.03 , 9.98 ± 0.03 and 7.56 ± 0.03 %, respectively. Camel milk has a higher level of Vitamin C and equal or higher levels of vitamins B1 and B12 than milk of other domestic animals [29] and this high level of vitamin C is especially important for the nomadic pastoralists as they face rarity of fruits and vegetables [30,31]. Reported ranges for fat and protein percentages were 2.60-3.20 and 3.73-3.89, respectively in Indian camel milk. In a later study [32] reported fat and protein percentages as 5.5% and 3.87%, respectively in Indian Bactrian camel milk. Reported mean values for fat and protein percentages of Mauritanian camel milk were 2.92 ± 0.59 and 2.50 ± 0.10 , respectively [33]. Shoel breed, first stage of lactation and settled system showed highest reported concentration of fat while Soffer breed, first stage of lactation and semi nomadic system showed highest concentration of protein [34]. Range for lactose percentage was to be 2.9-5.8% in dromedary camel's milk [35,15]. Reported percentage of lactose was to be 4.16% in Majaheim camel's milk in Saudi Arabia [17]. Mehaia MA, et al. [18] reported 4.43% lactose in Majaheim, 4.46% in Hamra and 4.44% in Wadah camel's milk, respectively in Saudi Arabia. Morin DE and Rowan LL [36] reported fat and sugar percentages as 2.7% and 6.5% in Llama camel's milk in USA. Reported mean value for percentage of lactose was to be 4.91 ± 0.61 % in Mauritanian camel's milk [33]. Soffer breed, first stage of lactation and semi nomadic system showed highest concentration of lactose while this value has been decreased by subsequent parity [34]. SNF and total solids percentages in camel's milk ranged between 8.9-14.3% and 11.5-17.8%, respectively. Mean values for SNF and total solids percentages were reported to be 9.00 ± 0.13 and 12.36 ± 0.19 , respectively in Pakistani camels [35]. In recent studies, [37] reported fat & protein percentage as 4.44 ± 0.46 and 3.42 ± 0.04 respectively in milk of Marecha dromedary she-camels under extensive conditions in Desert Thal. Faraz A, et al. [38] investigated milk yield and composition of Barela dromedary camel under extensive conditions in Desert Thal and reported fat and protein percentage as 4.26 ± 0.36 and 3.62 ± 0.06 respectively. The mean values and range of milk fat, protein, lactose, SNF and total solids of dromedary camel at Desert Thal were found to be 4.79 ± 0.48 , 3.56 ± 0.06 , 4.92 ± 0.05 , 9.09 ± 0.06 , 13.88 ± 0.09 and 3.95 - 4.98 , 2.85 -

3.96, 3.91-5.08, 7.62-9.67, 12.52-14.85, respectively [39]. Elamin FM and Wilcox CJ [17] reported 7.8% SNF and 10.95% total solids in milk of Majaheim camel in Saudi Arabia. Reported SNF and total solids percentages were 8.13% and 11.35% in Majaheim, 7.78% and 10.63% in Hamra and 7.61% and 10.07% in Wadah camel's milk, respectively in Saudi Arabia [18,30,31]. Reported ranges for SNF and total solids percentages were 7.25-8.25 and 9.85-11.45, respectively in Indian camel's milk. Reported SNF and total solids percentages were to be 9.18% and 14.68%, respectively in Indian Bactrian camel's milk. [32,33] reported mean values for SNF and total solids as 8.88±0.08 and 11.80±1.0 in Mauritanian camel's milk. Soffer breed, first stage of lactation and semi nomadic system showed highest concentrations of SNF and total solids while these values have been decreased by subsequent parity [34]. Mean values reported for titrable acidity and specific gravity were 3.57±0.09 and 1.03±0.007 in Pakistani camel's milk [35,15]. Mehaia MA, et al. [18] reported percent acidity values as 0.144 in Majaheim, 0.137 in Hamra and 0.140 in Wadah camel's milk, respectively in Saudi Arabia. [30,31] reported range for percent acidity as 0.12-0.14 in Indian camel's milk. Mean value reported for percent acidity was to be 16.1±1.2 in Mauritanian camel's milk by [33].

Average values for mineral composition were reported to be 49.42, 15.04, 0.55, 0.07, 0.22 and 1.42 mg/100gm of Na, Mg, Fe, Mn, Cu and Zn, respectively in milk of Kohi camels [16]. Elamin FM and Wilcox CJ [17] reported mineral contents as Ca (30.03), K (72.48), Mg (4.50), Na (43.10), Fe (0.28) and Pb (0.18) mg/100g in milk of Majaheim camels in Saudi Arabia. Reported mean values for Ca, Mg and P were to be 120.6±16.6 mg%, 11.2±2.0 mg% and 82.1±10.4 mg%, respectively in South Morocco camels. [40,41] reported range of Ca, Mg and P as 74.1-200.2 mg%, 5.9-115 mg% and 2.1-92.9 mg%, respectively in Somali camels. Reported mean values for Fe, Cu and Zn were to be 1.00±0.12, 0.44±0.04 and 2.00±0.02, respectively in Indian dromedary camels [42]. Camel milk contains higher values of trace minerals such as Fe, Zn and Cu as compared to bovine's milk [30,31]. Mal G and Pathak KML [32] reported Ca and P of Bactrian camel's milk in India as 0.11 and 0.09 percent, respectively. Meiloud GM, et al. [33] reported mean value for mineral contents in Mauritanian camel's milk as 1.30±0.09. Aljumaah RS, et al. [34] determined the factors like breed and production system that altered the milk composition of dromedary camels in Saudi Arabia and reported that Ca and K values were higher in Maghatier breed and in semi nomadic system.

Table 1: Comparison of camel milk composition (%) with other species [43].

Species	Fat	Protein	Lactose	Ash	Total Solids
Camel	4.9	3.7	5.1	0.7	14.4
Cow	4.5	3.8	4.9	0.72	13.9
Buffalo	7.6	3.8	4.9	0.78	17
Ewe	5.3	5.5	4.6	0.9	16.3
Goat	3.5	3.1	4.6	0.79	12
Mare	1.6	2.7	6.1	0.51	11
Ass	1.2	1.7	6.9	0.45	10.2
Reindeer	18	11	1.5	-	33
Elephant	15.1	4.9	3.4	0.76	26.9
Woman	4.5	1.1	6.8	0.2	12.6

Conclusion

Camel milk has great importance having rich contents and therapeutic peculiarities so worth considering for adults and infants. It can be used in people with allergies and lactose-intolerance in a safe way. It could be used to cure some diseases like liver disorders, long bone pain, joint problems, diabetes and may also be used as an aphrodisiac globally. As getting awareness it has become a peculiar diet having composition alike cow milk but with additional therapeutic worth; hence its use should be encouraged.

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Conflict of Interest

No conflict of interest.

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