

Camel Milk-A Review **Abdulqadir Abdullahi***

Animal and Veterinary Scientists, ASDSP
II, Mandera, Kenya

Corresponding author:

Abdulqadir Abdullahi

✉ abdulqadir1928@hotmail.com

Animal and Veterinary Scientists, Monitoring
and Evaluation Officer, ASDSP II, Mandera.

Tel: +253799758585

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Abstract

The article describes the role of camel milk in the human diet. Camel milk differs from other ruminant milk as it contains low cholesterol, low sugar, high minerals, high vitamin C and higher protective proteins like lactoferrin, lactoperoxidase, Immunoglobulins and lysozyme. Camel meat is a delicacy not to be missed during festivities. Male camels are also used for transportation of water, and of household items when families move to new grazing sites within the range. In addition, camels have an important role in traditional social relations, such as in payment of a dowry, and in compensation of injured parties in clan feuds. Camel's milk is unique in terms of antioxidative factors, antibacterial, anti-arthritis, antifungal, anti-hepatitis, antiviral, treatment for Paratuberculosis, prevent aging, remedy for autoimmune diseases and cosmetics. Camel milk lacks β -lactoglobulin and used as an option for the individuals intolerant to lactose of cow's milk. Insulin in camel milk is safe and efficacious in improving long-term glycemic control in a diabetic patient. Camel milk reduces autism symptoms in children. Lactoferrin in camel milk has the ability to inhibit the proliferation of cancer cell. Camel milk is rich in zinc and magnesium thus endowed antiulcer properties. Camel milk has high α -hydroxyl acids which are known to smoothies the skin and also used to treat skin disorders such as dermatitis, Acne, and Eczema. Although camel milk has such values, it's less appreciated thus its consumption is restricted to a pastoral area. Further studies should be conducted on the chemical composition and medicinal properties of camel milk.

Keywords: Camel; Milk; Protein; Breeds; Goat

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Introduction

Camels are important livelihood assets in arid and semi-arid areas in Kenya which covers approximately over 83% of the total landmass supporting 30% (12 million) of the Kenyan population. Camel as an animal resource provides a good source of food, income, and transport means, cultural functions among other uses by its keepers, the pastoral communities [1]. This pastoralist majorly keeps the one-hump camels (*Camelus dromedarius*) estimated to be 297 million [2]. The camel industry has the potential to produce 350000000 liters of milk annually and 10000 tons of meat per year [3]. In arid northern Kenya, the camel production has traditionally been under the pastoral production system [4]. Here camels are owned individually and commonly grazed in community-owned rangelands. It is characterized by subsistence farming with low input use and hence low output. There is also seasonal search for feeds, water, mineral lick and escape from ethnic resource-based conflict. It has been found that free herd mobility utilizing extensive rangeland resource is more suitable in the utilization of ASALs [5]. All these have been in an attempt to enable pastoralists to utilize extensive rangeland

resources more efficiently for milk, meat and other byproducts [6].

As climate change becomes more and more pronounced the importance of keeping camels in the ASALs is becoming more and more obvious. Camels have a range of advantage over other livestock in the dry areas as:

- Camels can stay for long periods without water
- Camels can travel long distance making them able to use forage far from water point where other livestock cannot reach
- Camels can produce much more milk than other livestock under ASAL condition
- Camels browse on trees so do not come for-Pete cattle and the small stock

Literature Review

Camel milk is a very important staple food for Kenyan pastoralists. During dry seasons camels will keep giving milk when milk from

other livestock has dried up hence the milk keeps pastoralists and their children from starving during droughts and periods of scarcity. The camel udder differs from those of other milk producing animals. Each of their teats has two or more teat canal. This is probably an adaptation. If one fails to function the others will release milk to the young one. Camel milk is also very healthy it contains 3 times more vitamin c than cow's milk so is the main source of vitamins and high-quality proteins for pastoralists. Allowing a balanced diet in arid lands where vegetable and fruits are hard to get and meat is only eaten occasionally. Camel milk thus prevents nutritional deficiencies in pastoralist's communities.

Camel milk is thought to have medicinal properties and traditionally is used to treat illness like diabetes and other chronic infections. Because of these properties, camel milk has high economic value and fetches more profit to farmers. The highest prices are paid for fresh clean camel milk, with sour milk fetching less. Because it stays fresh longer than cow's or goat's milk, it can be transported to more distant markets in towns and cities [7]. The user or consumers of marketed camel milk are from growing urban population like Eastleigh and Garrissa, with the later market consuming far the largest share of camel milk. Quality determines the demand for milk for aspects like good taste and cleanliness. Price seems to matter less since consumers will buy expensive long life milk if the informally marketed milk is not of high quality. Camel milk so-called white gold of the desert is more similar to human milk than any other milk and differs from other ruminant milk because it contains low cholesterol, low sugar, high minerals (sodium, potassium, iron, copper, zinc, and magnesium), high vitamin C, protective proteins like as lactoferrin, lactoperoxidase, Immunoglobulins lysozyme. Camel milk has been acknowledged for a long time to provide a potential treatment for a series of diseases such as dropsy, jaundice, anti-hypertensive, asthma and leishmaniasis.

Numerous reviews have been carried out in different animals' Milk in the world but since a camel is scientifically abandoned animal the importance and use of camel milk was not reviewed which created information gap in the area.

Therefore in line with the above, the objectives of this article are:

- To review available information on medicinal values of camel milk
- To recommend further investigation concerning medicinal

values of camel milk based on the information from this review

Milk quality and composition

Camel milk compares favorably with the milk of another animal [1] the major difference which is of special importance, is the high level of vitamin c in camel milk as reported by several authors vitamin c content in the camel milk 25-60mg/L which is almost 3 times that of cow's milk this is a vital contribution to the pastoral diet since fresh fruits and vegetables (the main source of vitamin c) are rare in ASALs areas [6]. This milk is generally opaque white with sweet and sharp taste that is sometimes salty, depending on the fodder consumed and the availability of drinking water compared to cow's milk, camel's milk sour very slowly and can be kept longer without refrigeration but storing it readily ferments to yoghurt the pH of camel milk range from 6.2-6.5 and the density is from 26-35 g/cm³ both the pH and density are lower than that of cow. Camel milk has better quality compared to that of other livestock like cattle and goats **Table 1**. Different factors influence camel milk composition. They include breed stage of lactation and milk production potential Mal and Sena found that protein content was highest while fat content was lowest in breeds with better milk production potential.

Adapted from: Wernery U [8]. Camel milk-New observation: in proceedings of international camel conference, Feb. 2007.

Chemical composition of camel milk: Camel's milk is generally an opaque white color and has a faint sweetish odor and sharp taste; sometimes it can be salty. Its opaque white color because of the fats are finely homogenized throughout the milk whereas, the changes in taste are caused by the type of fodder and availability of drinking water. Its density ranges from 1.026-1.035 and the pH from 6.2-6.5, both are lower than those of the cow's milk and maximum buffering capacity of skim milk is at pH 4.95.

According to most authors, the composition of camel milk varies due to the difference of geographical origin and year of publication of the published dates but other factors such as the physiological stage, feeding conditions, seasonal or physiological variations, genetic or health status of the camel have also paramount importance. In general, the average amount of components of camel milk is protein 3.4%; fat 3.5%; lactose 4.4%; ash 0.79%; while water covers 87%.

Table 1. Comparison of camel and cow milk compositions.

Parameter	Camel milk value	Cow milk values	Unit
Water	90	87	%
Total solid	10	13	%
Fat	2	4	%
Insulin	40.5	16.3	Pu/ml
Iron	0.05	0.27	Mg/100 g
Calcium	132	120	Mg/100 g
K	152	140	Mg/100 g
Zinc	0.5	0.4	Mg/100 g
Vitamin C	35	10	Mg/100 g
Niacin	4.6	0.6	Mg/l
Panthothenic acid	0.9	3.8	Mg/l

Water: Water is the most important factor in camel milk. Unlike other animals, the water content of camel milk increases during dehydration. With water freely accessible the water content of the milk is 86 percent, but when water is restricted the water content of milk rises to 91 percent. This is useful as a water source for dehydrated calf and the humans in the area where water is scarce. The reasons for the increment of the water content of milk of dehydrated camel are ADH secretion is elevated in the dehydrated camel, a decrease in the fat content and type of forage eaten.

Proteins: Milk proteins are a heterogeneous group of compounds that differ in composition and properties [9]. Dromedary camel milk contains 3 to 3.90 percent of protein **Table 2**. It contains two main groups (Caseins and Whey proteins and relatively higher amount of immune proteins (Peptidoglycan Recognition Protein, Lactoferrin Lysozyme, and Lactoperoxidase) and insulin). Casein is the most important and higher in proportion, while the proportion of whey proteins is relatively low. Shamsia, also confirmed that camel milk contains higher protein (especially casein) and lower in whey milk than human milk.

Casein is a major part of the protein in camel milk. Dromedary camel milk has 1.63% to 2.76% of casein protein that constitutes 52 to 87 percent of total milk protein. There are 4 main casein fractions casein: α_1 , α_2 -, β -, and κ . their proportion is diverse and polymorphism of these proteins was demonstrated in most of the animal species. The human casein does not contain the α_1 -fraction, which is the predominant factor causing milk protein allergy. However; it is rich in the β -fraction. But casein in cow and buffalo milk is very abundant (38.4% and 30.2% of total casein, respectively) in the α_1 -fraction. Milk protein allergy (MPA) is an allergic reaction to proteins commonly found in cow milk. In the whole casein portion, β -CN is 65 percent and α_1 -CN is 21 percent. Camel milk has more digestibility and less allergic reactions in infants as α -CN slowly hydrolyze than β -CN.

Whey protein is the second biggest fraction of protein of camel milk which covers 20 to 25 percent of camel milk protein. The milk of dromedary camel has a whey protein in the range of 0.63 and 0.80 percent. β -lactoglobulin is found in trace, while α -lactalbumin comprises the major camel milk portion. In the milk of bovines.

Advantages of camel milk in relation to other livestock milk: Among the major camel products utilized by pastoralists it is milk. Camels have a high capability to convert browse from trees and shrub into high-quality milk valued by pastoralist communities.

Other advantages are:

- Camels are able to yield a far much high quantity of milk

than the other animals under the same range condition. For instance, the *Bos indicus* cattle adapted to survive in ASALs are limited to 3-4 liters of milk per day particularly during favorable conditions right after the rains, whereas good camels under favorable conditions can reach up to 15-20 liters per day

- Camels have the potential of continued milk production provided they have good access to enough browse. Cattle that are found in the same condition stop lactating during drought
- Camel's milk is resistant to heat, the property that ensures longer shelf life even during extreme transportation conditions
- Camel milk has been perceived as a crucial food resource for pastoralists where it is believed to sustain life. It is a highly priced commodity fetching a better price than any other kind of milk
- There exists documented work reported in the literature and confirmed by medical studies that camel milk has medicinal properties
- Consumption of half liters milk daily has positive results for diabetes type one where it has been shown that it reduces the insulin needs in patients by up to or greater than 30%. Some patients have been reported to be symptom-free after a constant daily intake of camel milk [10]. It is important to use raw milk because excessive heating denatures the insulin protein in camel milk rendering it functionless
- Camel milk is also having positive effects in controlling hypertension as it restricts angiotensin-converting enzyme [7]
- Camel milk helps in the management of arteriosclerosis and osteoporosis. It has been shown that milk from camel has an antibacterial and anti-viral factor. Clinical trials show that patients with infectious diseases like tuberculosis have a significantly higher recovery rate if they consume camel milk
- Camel milk contains 3 times the content of vitamin c compared to cow's milk. The aspects of lactose intolerance in some people due to protein digestibility dysfunctions are minimal for camel milk consumers since it does not produce such reactions [11]
- Camel milk is important for autistic children. However, the camel dairy industry faces some major challenges particularly regarding the marketing of milk and related products like cheese and fermented milk. Proper hygiene

Table 2. Chemical composition of milk for different species.

Proximate	Water	Protein%	Fat%	Ash%	Lactose%
Camel	86-88	3.0-3.9%	2.9-5.4%	0.6-0.9%	3.3%
Cow	85-87	3.2-3.8%	3.7-4.4%	0.7-0.8%	4.8-4.9%
Buffalo	82-84	3.3-3.6%	7.0-11.5%	0.8-0.9%	4.5-5.0%
Sheep	79-82	5.6-6.7%	6.9-8.6%	0.9-0.1%	4.3-4.8%
Goat	87-88	2.9-3.7%	4.0-4.5%	0.8-0.9%	3.6-4.2%
Human	88-98	1.1-1.3%	3.3-4.7%	0.2-0.3%	6.8-7.0%

is paramount. Among the factors that contribute to poor hygienic standards of camel milk in the Arid and semi-arid areas are:

- Water shortages
- Traditional and primitive ways of milking
- High ambient temperatures
- Dusty environment
- Lack of knowledge pertaining or relative to clean milk production and hygienic handling

Clean milk production

It is important to protect milk from dirt and heat. This delays souring and keeps the milk fresh until it reaches the market. Fresh milk can fetch high prices, therefore, it is important to practice hygienic milking techniques. Clean milk production involves various considerations such as:

- The animal being milked
- The animal should be free from diseases because some diseases like brucellosis, tuberculosis can be transmitted to humans through milk
- The animal should also be physically clean and free from dirt. The udder may contain soil particles, bedding materials, dust, and manure. This should be thoroughly cleaned
- For pastoralists in areas where water is scarce, the milkman can clean the udder with clean dry hands to reduce the number of contaminants that would otherwise drop in the milk. Where water is not limited resource, water should be boiled and disinfected with chlorine and use for washing the udder before milking
- Also, ensure that hair from the animal's coat and tailor dribbles from the mouth of the calf are removed
- The person in charge of milking should avoid milk contamination. He or she should be disease free and should maintain high standards of hygiene. (Personal hygiene i.e. short nails)
- The milking environment should be dust free. Ensure you sweep or clean the milking area before milking. If there is a strong wind, choose an area away from the wind. Control insects particularly fly from the milking parlor. The environment should not contain injurious objects like wires and nails

Equipment for milking

Equipment and utensils used in the milking process, milk storage and transportation may be major sources of milk contamination if not well cleaned and handled. It is of importance to note that the number of utensils used to handle milk between milking and sale to final consumer should be as few as possible to minimize chances of contamination. The pastoralists commonly use wooden/woven milking containers in the storage of milk as long as they are properly cleaned and smoked. Plastic Jeri cans

are very unhygienic because they cannot be easily and properly cleaned inside. If smoking is tried, they melt where the coals heat the inside of the wall. The handles are hollow and can hide a lot of germs which no cleaning method can get rid of.

Proper hygiene is paramount for clean milk production since milk can transfer disease germs from animals or persons to customers if not hygienically produced.

The diseases which are transferrable in milk are Brucellosis, Tuberculosis, Scarlet fever, Cholera, Dysentery, Diphtheria, Typhoid and Mastitis

Brucellosis: It affects both humans and animals. It can be transmitted through uterine discharge and urine which may contaminate milk and milk man's hands. Therefore, it is advisable that the milkman should not touch urine, retained afterbirth or aborted fetuses that would otherwise be sources of brucellosis transmission.

Tuberculosis: An infected individual can contaminate milk through hands, sneezing or even breathing on to the milk. Camels can also be carriers of tuberculosis and transmission to humans through the consumption of raw milk.

Milk testing

For primary milk buyers there are four milk testing technique possible:

- California mastitis test: This measures whether there are major mastitis contaminations in the milk
- Organoleptic test: This test the appearance, smell and taste
- Lactometer: It measures if water has been added to milk
- Clot on boiling: Measures acidity, when milk is too sour to be boiled. Tablespoon of milk is held over a candle to see if it boils well. If it clots then the milk is contaminated

Discussion

Camel milk has the potential to address food and nutrition security as well as medicinal properties.

Medicinal properties

In the pharmaceutical industry, camel milk is gaining popularity relative to its perceived medicinal properties by pastoral communities [12]. It is further believed to have antimicrobial activities. Studies have also shown that this kind of milk has the capability to inhibit the growth of pathogenic bacteria and there have been demonstrations where 4 out of 6 such pathogenic bacteria have been inhibited [13]. The most recent documentation by researchers in this field showed that camel milk is known for diabetes, Tuberculosis, stomach ulcers, gastroenteritis and cancer treatments in the African rift valley and Asia [3]. This author reported that there exists evidence of some medicinal potential after critical analysis of camel milk.

Therapeutic values of camel milk

Health benefit potentials of camel milk are obtained through

a number of bioactive components in camel milk. A study conducted between July 2005 and January 2006 in Babilie and Kebribeyah woredas, Jijiga Zone of the Somali Regional State reported that respondents (97.5% and 85% for Babilie and Kebribeyah, respectively) recognized the medicinal value of camel milk. This research indicated the medicinal value of camel milk for treatment of gastritis, asthmatics, stomach discomfort, HIV, Hamot (kar), tuberculosis, fever, urinary problems, and hepatitis. Interviewed pastoralists claimed that camel milk is used to treat a number of illnesses in human beings such as Jaundice, Malaria, Constipation, to clear the stomach, post-partum care of women, to detoxify snake venom and flatulence, jaundice, malaria and constipation for reason that camels browse on various plant species and active agents with therapeutic properties from these plant species are secreted into the Milk. Camel milk has been acknowledged for a long time in different parts of the world to provide a potential treatment for a series of diseases such as dropsy, jaundice, tuberculosis, asthma, and leishmaniasis or kala-azar [4]. Also revealed that several studies have shown that milk is an important nutritional and functional source of food and provide particular health benefits due to the presence of bioactive substances in it. In the same way, in all camel rearing countries, the breeders are convinced that camel milk has special medicinal properties, especially for dropsy, jaundice, and conditions affecting the lungs and spleen.

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In comparison to cow's milk, it is reported that camel milk has up to 10 times high quantities of protein lactoferrin with some antiviral properties that exert immunological bactericidal and viricidal properties [14] Such components like lactoferrin are found to exert immune-enhancing functions both directly and passively. This has been critical to a wide range of immune challenges particularly for responses in humans. Scientists further confirmed fermented camel milk is high in lactic bacteria which are effective against pathogens including *Staphylococcus*, *Salmonella*, *Escherichia* antibacillus micro-organisms. Camel milk has immunoglobins similar to mother's milk which reduces children's allergic reactions and strengthens their future response to food. This was shown by a research done at the Ben-Gurion university of the Neger in Israel where researcher treated 8

children (age 4-10 yrs) with camel milk who were suffering from severe food allergies who had not responded to conventional treatment [14].

Lactose is present in camel milk at a concentration of 4.8% but it is easily metabolized by these suffering from lactose-intolerance. Camel's milk also includes a different (beta- casein to cow's milk and no B-lactoglobulin the two component of cow's milk that is most allergic [14].

Nutrition and food security

Camel milk production systems are of late undergoing adaptive changes and transformation associated with emerging and increasing food demand [15]. Feed requirements of the camel. The emergence of the peri-urban camel production system is encouraged through commercialization of camel milk resulting from increased demand by an urban population which helps in addressing the issue of food security in relation to vision 2030. There are reports that pastoralists are becoming less nomadic and production of milk for market purpose is gaining importance to match the sedentary life [16].

For instance, peri-urban camel dairy production has now spread to countries like Djibouti, Mauritania, Morocco, and Somalia. In northern Kenya, the high prices of camel milk are used as incentives attracting more and more pastoralists in camel keeping hence increase milk production. Urban market demand for camel products is on an increase in major Kenyan cities particularly Nairobi [1].

Conclusion

In conclusion, there is evidence that camel milk can address various issues like nutrition and food security as well as medicinal properties in Arid and semi-arid areas and the entire world.

Recommendation

In order to safeguard consumer health and strengthen the sources of income by camel producers through the sale of camel products, we recommend the following:

- Farmers should be trained on hygienic/clean milk production, good storage, and handling
- Universities to bring in live camels in the university to help students in teaching demonstration
- The government should provide support in terms of extension and research that will enhance further understanding and utilization of camel milk by Kenyans

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