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Camel Milk: A Ship of Nutrients

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Abstract: ***Camel milk is relatively new product for consumption for many people. Camel milk has the potential to contribute to human nutrition in hot and dry places of the world, since it plays a key role in the desert ecosystem. All of the key elements found in other milk are present in camel milk. Camel milk, both fresh and fermented, has been used for human consumption and the treatment of a variety of maladies in several parts of the world, including India, Russia, and Sudan. The physic-chemical and medicinal properties of camel milk are very impressive. This article reviews physic-chemical properties of camel milk, also comparing it with bovine milk and other available milk.***

Keywords: Camel milk, Milk composition, Human health, Nutritional values, Nutrients

1. Introduction

The camel (*Camelus dromadarium*) is an integral part of delicate desert ecology, a proven icon of adaptation thanks to its unique bio-physiological traits and formidable means of surviving in dry and semi-arid environments. Because of its indispensability as a medium of transportation and its ability to survive in the desert, the metaphorical Ship of desert got its moniker. From ancient times to the present, the camel has played an important part in civil law and order, defenceand wars. Camels are versatile animals that are utilized for milk, meat, and hide production, as well as transportation, entertainment, celebration, and competition similar to horse racing.

The camel has numerous special characteristics that enable it to survive and serve in difficult environments and to absorb low-quality feed resources that other animals cannot. In fact, camels are still the lifeblood of rural populations in distant settlements today. The camel was once primarily used as a draught animal in agricultural and transportation operations, but due to the mechanization of farm operations and transportation, its utilization for these purposes has severely decreased. As a result, in order to keep the camel population in these places afloat, camel husbandry practices are geared at promoting the camel as a dairy animal.

Food and Agriculture Organization (FAO, 2008)estimates that there are 22 million camels in the world today, with 89 percent being one-humped dromedary (*Camelus dromedarius*) camels and 11 percent being two-humped Bactrian (*Camelus bactrianus*) camels, which are mostly found in Asia's cold deserts. In India, camels make up about 0.08 percent of the overall animal population. According to the 2012 census, there are 0.4 million camels in the country (DAHDF, 2014). The population of camels has declined by 22.48 percent since the last census, and they are mostly found in Rajasthan, some portions of Gujarat, Haryana, Punjab, and a few other states.

Camel milk has been used medicinally by people for generations since it is more similar to human mother's milk and better than cow's milk. It's more akin to goat's milk. It has an opaque appearance and a sweet, crisp flavor; however it can be salty at times. It has a density of 1.026-1.035 and a pH of 6.2-6.5, both of which are lower than cow's milk. When compared to cow's milk, it sour slower and may be kept longer without refrigeration. Milk output in camels has been estimated to be between 17 and 26 liters per day (Knoess et al., 1986).The amount of milk produced depends on the breed, stage of lactation, management circumstances, and diet. Camels generate diluted milk when water is lacking in hot conditions (Omar, 2004).

Another advantage of camel milk is that the milk of dehydrated camels is high in salt and water content while maintaining the same nutritional value. According to a study, dehydrated camel milk contains higher levels of sodium, potassium, phosphorus, and chloride, but calcium and magnesium levels are lower. When compared to the milk of hydrated camels, there was a higher concentration of water (Yagil, 2004).

Milk Production

Camels can produce more milk and for longer periods of time than any other species under the severe circumstances of the desert ecosystem, but their nutrition requirements are modest. In a lactation period of 8-18 months, total milk output ranges between 2,000 to 4,200 L. The daily milk production is expected to be between 3 and 10 kg on average, with the yield potentially increasing to 20 L per day with better nutrition, husbandry, water availability, and veterinary care(Kumar et al., 2016).

Physicochemical Composition of Camel Milk

Camel milk has an opaque white appearance, is frothy, and has a slightly salty flavour. This could be due to the dry region's plants and herbs providing food. Camel milk has a lower viscosity than bovine milk, with an average density of 1.029 g cm^{-3} (Laleye et al., 2008). Fresh camel milk has a pH range of 6.4 to 6.7. Camel milk has a freezing point of -0.57°C to -0.61°C. Camel milk has a calorific value of 665 Kcal/L, while cow milk has a calorific value of 701 Kcal/L. Its greatest buffering capacity is at pH 4.95 (Gul et al., 2015). The content of camel milk has been found to be influenced by the camel's physiological stage, feeding conditions, season, physiological fluctuations, genetic make-up, and health state (Konuspayeva et al., 2009). In general, camel milk contains 3.4 percent protein, 3.5 percent fat, 4.4 percent lactose, and 0.79 percent ash, with water covering 87 percent of total content(Al Kanhal, 2010).

The composition of camel milk was discovered to be less stable than that of other species, such as bovine milk. However, variations in camel milk composition can be related to a variety of factors, including analytical assessment processes, geographical locations, feeding conditions, and samples collected from various breeds, as well as lactation stage, age, and calving number (Khaskheli et al., 2005). The most effective elements in camel milk composition were determined to be geographic origin and seasonal fluctuations. According to Konuspayeva *et al.* (2009) mentioned the geographical effect on camel milk composition with larger fat content in East African camel milk than camel milk from Africa and Western Asia. Camel milk has a water content ranging from 87 to 90%. Total solids in camel milk were found to have an inverse association with camel water intake (Haddadin et al., 2008).

Table 1: Comparison of camel and cow milk compositions

Parameter	Camel milk	Cow milk	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

Note: Adapted from Camel milk-new observations. In Proceedings of the International Camel Conference" Recent trends in Camelids research and Future strategies for saving Camels", by U. Wernery, 2007.

Table 2: Proximate chemical composition of camel milk and other species' milk

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%

Note: Adapted from Encyclopedia of dairy sciences, by H. Roginski, J. Fuquay, & P. Fox, 2003.

Milk protein

Camel milk has a total protein level ranging from 2.15 to 4.90 percent. Camel and cow milk have identical casein concentration, however camel milk has a greater whey protein proportion. Camel milk has a greater whey protein to casein ratio than cow and human milk proteins. This could explain why camel milk's coagulum is softer than cow milk's. Casein (CN) is the most abundant protein in camel milk (1.63-2.76%), accounting for 52 to 87 % of total proteins. The β-CN content is higher than the α-CN content, accounting for around 65 and 21% of total casein, respectively. While in bovine milk it contains 36 % of β-CN and 38% of α-CN. Camel milk has κ-casein level of roughly 3.47 percent of total casein, compared to 13% in bovine milk. Whey proteins make up roughly 20-25 percent of total proteins and 0.63 to 0.80 percent of milk. Camel milk contains the majority of the two major whey proteins, α-lactalbumin, and the deficient one β-lactoglobulin (Laleye*et al*., 2008).

Serum albumin, lactoferrin, immunoglobulins, and peptidoglycan recognition protein are among the other whey proteins found in camel milk. Camel milk proteins contain strong antibacterial, antiviral and antifungal substances and the immune globulins (Kappeler, 1998).

Aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma glutamyltransferase (γ-GT), acid phosphatase (ACP), alkaline phosphatase (ALP), and lactate dehydrogenase are among the enzymes found in camel milk (LDH). These enzymes are crucial in maintaining the quality of camel milk. γ -GT can be used to determine whether camel milk has been properly heated (Werney, 2007).

Table 3: Average concentrations of lactoferrin, lysozyme and immunoglobulins G in milk of different species (mg/l)

Specification	Lactoferrin (mg/l)	Lysozyme (mg/l)	Immunoglobulins G(mg/l)
Human	700–2000	100–890	40–54
Cow	80–500	0.37–0.60	100–800
Buffalo	50–320	0.13–0.15	460–1300
Camel	200–728	0.73–5.00	2000
Goat	98–150	0.25	100–400
Ewe	140	1–4	500
Mare	820	400–890	390

Source: Park, 2006, El-Hatmi *et al*., 2007, Wheeler *et al*., 2007, Konuspayeva *et al*., 2009, Stelwagen *et al*., 2009, Dračková *et al*., 2009, Liu *et al*., 2009.

Milk fats

Camel milk fat content varies from 1.2 to 4.5 percent depending on nutrition, lactation stage, breed, season, and other factors. When compared to other species, camel milk fat has a larger amount of unsaturated fatty acids. This could be the primary cause of camel milk fat's waxy texture (Zhang et al., 2005). When compared to bovine milk fat, dromedary camel milk fat has a higher amount of long-chain fatty acids (Konuspayeva *et al*., 2009).Camel milk contains a lower concentration of carotene than bovine milk (Stahl *et al*., 2006). The lighter colour of camel milk fat may be due to the reduced carotene concentration. Camel milk contains a variety of fatty acids, including butyric, caproic, caprylic, capric, lauric, myristic, myristoleic, palmitic, palmitoleic, stearic, oleic, linoleic, and arachidonic acids (Narmuratova et al., 2006).

Sugar

Lactose is the most abundant carbohydrate in milk. Lactose in milk is easily digested by the human enzyme lactase, and it does not cause lactose intolerance in people. It ranges between 4.8 and 5.8% (Abdurahman, 2004)and the value remains stable throughout lactation.

Mineral content

Camel milk has a total mineral concentration of 0.60 to 0.90 %. Camel milk is higher in Cu and Fe than cow milk and contains more Zn, Fe, Cu, and Mn. Ca, Mg, P, Na, and K concentrations in camel milk are nearly identical to those seen in cow milk. Camel milk is high in chloride due to the

fodder that camels eat, such as Atriplex and Acacia, which has a high salt content. Another reason for the salty taste in camel milk could be a decrease in main milk components and an increase in chloride concentration in milk from dehydrated camels (Yagil & Etzion, 1980). Camel milk has a Ca:P ratio of 1.5, compared to 1.29 and 2.1 for cow and human milk, respectively. This ratio is significant because infant formula made from cow's milk includes a lot of phosphate, which can cause hyperphosphatemia and low serum calcium.

Vitamins

Camel milk is higher in niacin and vitamin C than cow milk when it comes to water-soluble vitamins. Camel milk has modest levels of vitamin B1, B2, folic acid, and pantothenic acid; nevertheless, it has high levels of vitamin B6 and B12, which are comparable to cow milk and higher than human milk. Vitamin A level in camel milk is believed to be lower than in bovine milk, ranging from 100 to 380 g/L. According to the USDA (2009), camel milk (250 ml) provides an adult with about 15.5 percent of the recommended daily intake of cobalamin (B12), 8.25 percent of riboflavin (B2), 5.25 percent of vitamin A, and 10.5 percent of the recommended daily intake of ascorbic acid (C), thiamin (B1), and pyridoXine (B6). When compared to cow's milk, camel milk contains two to three times the amount of vitamin C. (Stahl et al. 2006). Because of the lower pH caused by the higher vitamin C concentration, the milk can be maintained for longer periods of time without forming a cream layer. The presence of a significantly higher level of vitamin C in camel milk is important from a nutritional standpoint, as it has strong antioxidant properties (Mal et al., 2007).

2. Conclusion

Camel milk is noted for its nutritional value, which includes being high in vitamins C and A while being low in SFA, having smaller fat globules, and being easy to digest while also being high in minerals and bioactive chemicals. For those living in arid and semi-arid environments, fresh camel milk and their products are a good source of nutrition. Camel milk production is gradually expanding as customer demand in the product has grown in recent years. Camel milk was discovered to differ from milk from other animal species, such as bovine milk, in some ways. Depending on the availability of bioactive compounds in milk, fresh and fermented camel milk has been claimed to provide specific health benefits to consumers. Many studies have looked at the medical benefits of camel milk and its link to a lower prevalence of diabetes types I and II, but more research is needed to understand the mechanism of action of the insulin-like small molecules that may be responsible for camel milk's anti-diabetic qualities. More research is needed to determine the significance of camel milk in the treatment of gastrointestinal ulcers, liver illnesses, and dermatological autoimmune diseases, to name a few. Furthermore, camel milk has been shown to be a rich source of natural bioactive chemicals and antibacterial agents, which could be used to build functional and health-promoting goods for the human population in the coming years.

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