

Camel milk: Natural medicine - Boon to dairy industry

Rohit Panwar²; Chand Ram Grover¹; Vijay Kumar²; Suman Ranga² and Narendra Kumar²

¹ Principal Scientist; ²PhD Scholars; Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal, 132001 (Haryana), India

Corresponding Author:

Dr. Chand Ram Grover, Principal Scientist, Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal, 132001 (Haryana), India

Email: dmcaft2011@gmail.com

Introduction:

Ayurveda has referred medicinal value of camel milk under the classification of “Dugdha Varga”. The camel has also been mentioned among the animals as miracle of God in the Quran. It is common practice to let camels to eat certain plants in order to use the milk for medicinal purpose. According to FAO statistics, there are 19 million camels population in the world, of which 15 million are in Africa and 4 million in Asia. Out of this estimated world population, 17 million are believed to be one-humped dromedary camels and 2 millions two-humped (Farah *et al.*, 2004). The camel is multi-purpose animal with high productive potential. In the time of global warming, growing deserts and increasing scarcity of food and water, may make camel a potential candidate to overcome some of these problems. The camel is an excellent source of milk under these conditions. Indeed, countries like Afghanistan, Algeria, Ethiopia, Kenya, Iran host large populations of camel and therefore, its milk is an integral part of human diet. Most of the camels are kept by pastoralists in subsistence production systems. They are very reliable milk producers during dry seasons and drought years, especially during milk scarcity from cattle, sheep and goats.

Camel milk is a valuable food with a long history of its use for thousands of years in many cultures. In many countries, camel milk is being given to babies suffering from malnutrition and thus has emerged as a new super food with miraculous health benefits. It may not be everybody’s cup of tea, however switch over to camel’s milk due to recent research on its therapeutic attributes, it could be a boon to alleviate lifestyle diseases. It is considered a very healthy drink

due to low fat and cholesterol content in comparison to cow or goat milk. It also contains three times more Vitamin C and ten times higher iron content than cow milk.



Figure 1: (Source: <https://www.google.co.in>)

Camel milk production perspective:

The camel dairy farm located at National Research Centre for Camels (NRCC), Bikaner (Rajasthan), India produce sufficient quantity of camel milk on daily basis to meet the demand of diabetic patients of the region at subsidized price. Recently, the European Union has also allowed the import of camel milk from African and Asian countries in their region. The camel milk production has become a booming trade in the Middle Eastern countries. As camel milk has gained popularity globally, India is now warming up to the idea of camel milk production and consumption. The Gujarat Cooperative Milk Marketing Federation's (GCMMF) Sarhad Dairy, based in Kutch, could begin camel milk production soon. This is the country's largest dairy cooperative, which markets milk and milk products under the Amul brand. Amul now plans to process and market camel milk in India. Till date, there are no microbiological standards for camel milk exist. Food safety and standards authority of India (FSSAI) is also yet to formulate standards for camel milk. The animal husbandry departments of Gujarat and Rajasthan, as well as NRCC, Bikaner, have approached FSSAI to formulate standards for camel milk since these two states have a significant camel's population. Camel milk is known to be closest to human milk and even can be easily digested by infant. Research studies around the world has also confirmed that camel's milk has better nutritional value as it exhibits many unique and amazing health promoting properties as compared to cow's milk.

Camel milk has been as medicine for centuries by nomadic people because its richness in vitamins, minerals and iron. This also possesses unique, powerful immune-system boosting components which would exert potential health benefit to consumers towards life style and genetic disorders like diabetes, allergies, cancer, arthritic, tuberculosis, autism, liver disease etc.

Chemical composition of camel milk:

Camel milk is considered a very healthy drink because of low fat and cholesterol level. Further, modern medical studies showed its effectiveness for the treatment of various life style disorders. The milk consists of enough nutrients to sustain a person healthy throughout the day without consumption of any other foods. Normally it is opaque white in color with normal odor sweet and sharp taste, but sometimes it is salty due to various physiological factors. The chemical composition of camel milk has been presented in Table 1.

Table 1: 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	0.6-1.0	3.3-5.8
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	0.9-1.0	4.3-4.8
Goat	87-88	2.9-3.7	4.0-4.5	0.8-0.9	3.6-4.2
Human	88-89	1.1-1.3	3.3-4.7	0.2-0.3	6.8-7.0

Source: (Fox, 2003)

Moisture and protein have been observed to be higher as compared to fat content. Therefore, camel milk can exert definite health benefits on human host (Mal *et al.*, 2010; Konuspayeva *et al.*, 2009). In addition, it is rich source of minerals, vitamins, enzymes, fatty acids etc.

Various minerals *viz.*, Na, K, Ca, P Mg Fe, Zn, Cu and vitamins (A, E, C and B1) are present in camel milk (Onjoro *et al.*, 2003; Khasmi *et al.*, 2001). The concentration of vitamin C in camel milk is 2-3 times higher as compared to cow milk. The low pH due to higher concentration of vitamin C, stabilizes the milk and therefore it can be kept for relatively longer periods without

cream layer formation. The availability of relatively higher amount of vitamin C in camel milk is of significant relevance from the nutritional point of view as it exerts powerful anti-oxidant activity (Mal *et al.* 2007).

Various fatty acids such as butyric, caproic, caprylic, capric, lauric, myristic, myristoleic, palmitic, palmitoleic, stearic, oleic, linoleic and arachidic acids are present in camel milk (Narmuratova *et al.* 2006). They may penetrate antigens and boost the effectiveness of the immune system to fight against the antigens. Some researchers claim high concentrations of linoleic acid among other polyunsaturated fatty acids in camel milk, which are essential for human nutrition. In addition, small-sized disease-fighting immunoglobulins are also part of milk constituent.

Camel milk also contain enzymes *viz.*, aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma glutamyl transferase (γ -GT), acid phosphatase (ACP), alkaline phosphatase (ALP) and lactate dehydrogenase (LDH). These enzymes play an important role in keeping quality of camel milk. Gamma glutamyl transferase can be used as an indicator for the proper heat treatment of camel milk (Wernery, 2007). This also contains number of protective proteins *viz.*, lysozyme, lactoferrin, lactoperoxidase, peptidoglycan recognition protein (PGRP). These proteins possess broad spectrum antimicrobial activity and thus have the ability to enhance shelf life of camel milk.

Shelf life of camel milk:

The unprocessed camel milk has shelf life of 5 days at 7°C. Whereas shelf life of pasteurized milk is 22 days, when heated at 65°C for 20 minutes and kept at 7°C. The fresh milk can also be stored for one year in frozen condition.

Therapeutic attributes of camel milk:

The camel milk is being consumed for centuries by nomadic peoples due to its nutritional and medicinal properties. The medicinal properties of camel milk can be attributed due to presence of protective proteins, which may possibly play pivotal role for enhancement of immune defense mechanism. Antibacterial and antiviral activities of camel milk proteins have been investigated

e.g. inhibit *Mycobacterium tuberculosis* (Sharma *et al.*, 2014). In addition camel milk also plays an important role to control number of health disorder such as diabetes, allergy, autism etc.

Diabetes:

The camel milk is not only low in fat and cholesterol but it also contains desired level of vitamins and minerals, as well also a rich source of insulin. The study conducted by India's Bikaner Diabetes Care Research Center during 2005, observed beneficial effects of camel milk consumption on type-1 diabetes as it significantly reduced insulin doses required to maintain long-term glycemic, or blood sugar level under control. Several other researchers; Breitling *et al.*, (2002) reported that camel milk contains high level of insulin which can therefore be used to treat diabetes mellitus type I. Similarly Widdel *et al.*, (2004) demonstrated insulin concentration of 32 $\mu\text{U}/\text{ml}$ which were higher as compared to 23 $\mu\text{U}/\text{ml}$ in cow milk. Camel milk can be used as an adjunct to insulin therapy as it appears to be safe and efficacious in improving long-term glycemic control and also helps in the reduction of insulin requirement in type 1 diabetic patients (Agrawal *et al.*, 2011). The results of epidemiological, animal experiments and clinical research of camel milk revealed that its consumption can help to prevent and treat diabetes.

Allergies:

The milk protein *i.e.* β -lactoglobulin present in cow and mare milk is responsible for allergies in humans. However, camel milk known to be lacking of this protein and thus do not pose problem of allergies in sensitive individual. β -casein present in cow milk also causes hypersensitivity into humans. Although, camel milk also contains β -casein, but the structure of camel milk protein is very different from the cow milk protein. According to El-Agamy *et al.*, (2009) absence of immunological similarity between camel and cow milk proteins may be taken an important criterion from nutritional and clinical points of view. Therefore, camel milk may be suggested as a new protein source for nutrition for children allergic to cow's milk.

Autism:

Extensive investigations have demonstrated that oxidative stress plays a vital role in the pathology of several neurological diseases including autism. The camel milk has emerged to have potential therapeutic effects in patient suffering from autism. The consumption of camel milk in children suffering from autism showed reduction in autism symptoms and improved

motor skills, language, cognition, joint coordination and skin health. The previous selected studies evaluated the effect of camel milk consumption on oxidative stress biomarkers using the ELISA technique in autistic children, by measuring the plasma levels of glutathione, superoxide dismutase, and myeloperoxidase before and after 2 weeks of camel milk administration. The all observations revealed that measured parameters exhibited significant increase after camel milk consumption. These findings suggest that camel milk could play an important role in reduction of oxidative stress by increase in antioxidant enzymes and non-enzymatic antioxidant molecule levels, as well as showed improvement of autistic behavior in children (Laila *et al.*, 2013). In a research conducted in King Saud University, Saudi Arabia, Al Kanhal (2010) examined the effect of camel milk against cow milk on 60 children aged 2-12 years old suffering from autism by feeding 500 ml/day of camel milk for 14 days. Out of 60 children, 25 and 24 received boiled and raw camel milk while rest 11 cow's milk. Hematological analysis reveal low level of antioxidants in all the children's at the initial stage of study. However, both groups of children fed on camel milk showed less oxidative stress at the end of two weeks as well as gradual improvement in behavioral and cognitive test for camel milk and autism.

Antimicrobial activity:

Camel milk contains various protective proteins, mainly enzymes which exert antibacterial and immunological properties. The presences of these proteins explain some of the natural healing properties of the milk. The known protective proteins such as lysozymes: participates in primary immune system, which is based on targeting of structures common to invading pathogens.

Immunoglobulins: These give immune protection to the body against infections.

Lactoferrin: Iron-saturated lactoferrin prevents microbial growth of undesirable microorganism in gut. Camel milk apparently contains much more lactoferrin than ruminant (cow, sheep and goat) milk.

Lactoperoxidase: It exerts bactericidal activity mainly against Gram's negative bacteria (Mullaicharam *et al.*, 2014).

Anti aging:

Camel milk has anti aging effect due to presence of α -hydroxyl acids which are known to plump the skin and smooths fine lines. Alpha- hydroxyl acids help to shed the outer horny layer of

dead cells on the skin (epidermis) by helping to break down sugars, which are used to hold skin cells together. This helps in revealing new cells, which are more elastic and clear. Alpha-hydroxyl acids helps to eliminate wrinkles and age spots and relieve dryness as they make the outer layer of the skin thinner and support the lower layer of the dermis by making it thick. In addition, liposome occurring in camel milk is applicable for a potential cosmetic ingredient to improve anti-aging effect (Choi *et al.*, 2013).

Antitumorigenic potential:

Anti-tumor properties of camel milk are due to strong antimicrobial and anti-oxidative activities that help in reduction of liver inflammation. This also has many nutrients that are required for healthy liver function. Korashy *et al.*, (2012) investigated the molecular mechanisms that govern the effect of camel milk on human cancer cells. This study clearly demonstrated that camel milk induces apoptosis in human hepatoma (HepG2) and human breast (MCF7) cancer cells through apoptotic- and oxidative-stress-mediated mechanisms. In addition, camel milk also has antigenotoxic and anticytotoxic effects through inhibition of micronucleated polychromatic erythrocytes (MnPCEs) and improves the mitotic index of bone marrow cells (Salwa *et al.*, 2010). Habib *et al.*, (2013) examines the functional properties of camel milk lactoferrin, the main iron binding protein of the milk which showed 56% reduction of cancer growth.

Arthritis:

Camel milk has higher amount of iron chelating protein known as lactoferrin. This protein removes free iron from joints of arthritic patients thereby improves arthritic.

Conclusions:

Camel is a multi-purpose animal with huge productive potential and has been utilized by humans for transport, milk, meat and skin. Camel milk and their products act as good source of nutrients for the peoples living especially in the arid and urban areas. The production of camel milk has gradually increased due to an increased interest of consumers in recent years. This has valuable nutritional and therapeutic properties as it contains high proportion of antibacterial and antioxidant substances like vitamin C as well as iron in comparison to cow milk. Regular intake of camel milk helps to control blood sugar levels. This also prevents variety of infection including gastroenteritis, tuberculosis, and cancer. The camel milk also cures severe food

allergies and rehabilitates the immune system in children. Further, there is enormous scope for preparation of functional fermented foods from camel milk. However, detailed *in- vivo* and *in- vitro* studies are warranted to substantiate its medicinal properties for healthy populations on the mother earth. Therefore, camel's milk processing would be a boon to dairy industry to fetch the premium price for its products.

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