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Camel Milk as a Forgotten Super Food: A Review of its Nutritional Benefits for Lactose-Intolerant Individual

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Abstract

Camel milk, often overlooked in modern diets, emerges as a potent superfood with exceptional nutritional and therapeutic benefits. People tend to ignore camel milk in their diets but its nutritional value and healing potential make it an exceptional superfood for people who cannot tolerate lactose. Bioactive compounds present in camel milk create functional food benefits because the milk demonstrates antibacterial properties as well as antiviral and antioxidant properties alongside hypoallergenic properties that attract growing worldwide attention. The nutritional values that make camel milk special include elevated amounts of vitamin C in addition to unsaturated fatty acids together with proteins that assist digestion and boost the immune capability. The digestion process of camel milk produces no coagulum and its lactose content remains low which makes it a suitable choice for those with lactose intolerance problems. Camel milk shows significant medicinal potential through its management of diabetes and immune boost effects and ASD symptoms reduction. The paper addresses camel milk's historical legacy before demonstrating how it could work as a sustainable health-food for today's consumers.

Keywords: Superfoods, Camel milk, Lactose intolerance, Digestive health, Bioactive compounds, Functional food

1. Introduction

The Food and Agriculture Organization (FAO) recently published data showing that the world has an estimated 20 million camels, with the largest herd found in Somalia (FAO, 2008). The Camelus genus has two different types of camels, which exist in the large pastoral areas of Asia and Africa. The Bactrian camel (Camelus bactrianus, two-humped) lives in temperate climates, while the Dromedary camel (Camelus dromedarius, one-humped) lives mostly in arid desert areas. The Bactrian species is domesticated in Asia Minor and Southern Russia, including Mongolia and Kazakhstan, while in the East it lives in Northern China.

In the past, camels have been a vital part of pastoral tribes' survival by providing necessary goods including meat, wool, and milk. The distinctive natural qualities of camel milk, in addition to its nutritional and therapeutic advantages, are responsible for its growing appeal. Despite its significance, just 0.2% of the world's milk supply comes from camels, compared to over 85% from cows and 11.0%, 2.3%, and 1.4% from sheep, goats, and buffalo, respectively (1,2,3,4).

1.1 Composition of Milk

The composition of camel milk matches human maternal breast milk more closely than any other animal product. The mineral content of camel milk exceeds that of standard milk products and it contains low levels of cholesterol with minimum sugar content. Apart from its medicinal values the milk provides ideal nutrition for people who lack the ability to digest lactose (51).
Since it can drink over 100 liters of water at once and go more than a week without drinking, the camel is a special animal that was tamed over 4,000 years ago and has long been referred to as the "ship of the desert" in dry and semi-arid regions. Known as the "white gold of the desert," camel milk has long been a valuable food source and drink for nomadic people who travel around in the arid regions of Africa, as well as southeast, west, and central Asia.
According to recent research, camel milk has high levels of vitamin C, long-chain unsaturated fatty acids, and no β-lactoglobulin, all of which are nutritionally significant. Camel milk's high iron content supports its possible therapeutic benefits, which are widely held among nomadic peoples. When camel milk is fermented with endogenous bacteria, the resulting dairy products may have health benefits **(52).**

2. Camel Milk: A Forgotten Superfood

Recent research indicates that camel milk may have several health advantages, including antibacterial, antiviral, antioxidant, anticancer, and hypoallergenic properties. Camel milk has also become more and more popular as a dairy alternative for those who are lactose intolerant. Nevertheless, despite increased awareness, its use is still limited in arid and semi-arid regions. The camel milk industry, which was formerly mostly associated with subsistence farming in arid and semi-arid regions, is currently a rapidly growing sector of the global dairy market. As consumer preferences shift toward functional foods and alternatives to cow's milk, camel milk has attracted a lot of attention because of its unique nutritional properties and potential health advantages (5).

2.1 Nutritional Composition of Camel Milk

Component	**Percentage**
Water	86–91%
Protein	2.9–4.9%

Fat	1.2–6.4%
Lactose	2.4–5.8%
Ash	0.7–0.9%
Total solids	9.5–14.5%

Various worldwide compositional analyses of camel milk have been conducted throughout India and resulted in significant differences between laboratory findings. The primary constituents of camel milk match those of bovine milk although total solids quantities at 11.8% prove slightly lower than bovine milk's 12.33%. The advantages of drinking camel milk over regular cow milk become apparent because camel milk contains lower concentrations of both total solids and fat (6,7,8,9). However, a variety of factors, including as geographic locations, feeding conditions, analytical measuring methods, and samples collected from various breeds, may contribute to variances in camel milk content in addition to other characteristics like age, calving number, and lactation stage. Geographic origin and seasonal variations are found to be the most effective components in camel milk composition (10).

2.2 Overview of key nutrients

Camel's milk is often opaque white, has a strong flavor, and occasionally has a salty taste. It also smells slightly sweet. Five publications comparing camel milk to other milks were examined in a meta-analysis published between 1905 and 2006. The FAO reported the following conclusions (see below). On average, camel milk contains 3.1% protein, 3.5% fat, 4.4% lactose, 0.79% ash, and 11.9% total solids. The water content in camel milk is the most important factor. Its overall solid composition is similar to that of human milk (11,12,13).

2.2.1 Proteins and amino acids

Multiple research studies have determined camel milk protein levels to exist between 2.9 and 4.9. Camel milk proteins exist as two distinct groups which include caseins together with whey proteins. Whey proteins constitute important components of camel milk alongside caseins and each protein plays a different role in the composition. The protein content in camel milk shows high quantities of amino acids with the exception of lysine that and glycine that and threonine alongside valine. Among all protein compounds found in camel milk whey proteins contain albumin together with lactoferrin and immunoglobulins and more (14).

2.2.2 Fats content

The range of fat content in dromedary camel milk is 1.2% to 6.4%. Camel milk has a low content of short-chain fatty acids but a high content of long-chain fatty acids. Additionally, camel milk

has an excessive amount of unsaturated fatty acids and linoleic acid, which is important for nutrition. There have also been reports on the total amount of camel milk lactose. Camel milk has a range of nutrients from several categories, including water-soluble and fat-soluble elements from diets A, E, D, and B. It is also rich in minerals, especially calcium and kalium (15,16).

2.2.3Carbohydrates content

Camel milk contains approximately 4.1% lactose which spreads between 2.4% to 5.8% according to the analysis conducted on this milk type. The lactose content in cow milk exists between 3.7% to 5.2% but this level changes due to drinking water volume and plant type. Scientists consider camel milk an excellent source of oligosaccharides which represent complex carbohydrates. Oligosaccharides function as prebiotics in the body due to their biological role (17).

2.2.4 Mineral content

Minerals are responsible for the physical status and stability of milk proteins by maintaining the salt balance. Some minerals like calcium (Ca^{2+}), magnesium (Mg^{2+}), phosphate (P^{3-}), and citrate (Cit^{3-}) maintain the salt balance. This may be controlled by diet, lactation, or the health status of the animal. The relative proportions of principal minerals in camel milk seem to be comparable with those of cow milk. Camel milk functions as a rich source of important minerals according to these studies. The consumption of one liter of camel milk fulfills 100% of the recommended daily calcium and phosphorus allowance while giving 57.6% of potassium and 40% of iron, copper, zinc, and magnesium to the body. Camel milk contributes to twenty-four percent of the daily recommended sodium intake. The research demonstrates that camel milk contains a wide array of nutrients which focus on its mineral composition. The availability in camel milk of sufficient quantities of calcium, phosphorus, potassium, iron, copper, zinc, magnesium, and sodium indicates its potential as a worthy source of these minerals. Ingestion of camel milk can help towards fulfilling the daily mineral needs of individuals (18,19).

2.2.4 Vitamin Content

The study evaluates vitamin contents between cow milk and camel milk products. Both milk types demonstrate dissimilarities in that cow milk carries higher amounts of vitamins A, E and B1 than what exists in camel milk. Camel milk contains much lower vitamin concentrations than what is present in cow milk. The riboflavin, folic acid and pantothenic acid levels in camel milk exist at 4 percent and 3 percent and 4 percent of cow's milk levels (20). However, compared to cow's milk, camel milk has higher concentrations of several vitamins. Compared to cow milk, camel milk has a vitamin C level that is roughly two to five times higher. Furthermore, compared to cow milk, camel milk has five times the amount of niacin. It is important to note, though, that camel milk does not contain enough β-carotene (21, 22,23).

3. Lactose Content and Digestibility

Due to its high nutritional value and prospective therapeutic aspects, CM has attracted increasing interest in recent years. Compared with bovine milk, CM is characterized by its lower casein/whey proteins ratio and higher β-casein/α_{S1}-casein ratio. The definite profile of CM casein fractions and

the large size of its casein micelles are the key players in the formation of a weak curd upon acidification during the manufacture of fermented CM products **(24).**

recently conducted a dynamic in vitro gastric digestion study of CM. Unlike bovine milk, CM did not form a coagulum during digestion, and no coagulum remained in the stomach. Instead, CM formed small particles composed of caseins that were rapidly emptied from the stomach. The particle structure became more spherical and compact over time, with αS1-casein being more highly digested than β-casein. This structural shift was attributed to the neutralization of protein negative charges and colloidal calcium phosphate dissolution as the pH decreased, as well as to changes in peptide and protein profiles. The association of fat globules with protein particles also increased as the pH decreased. After 60 to 120 min, the particle size of the drained digesta decreased and stabilized, with no intact proteins remaining. This indicates a high overall rate of gastric digestion and emptying (25,26).

Compared to cow's milk, camel milk contains less lactose. Only one study showed if individuals who are lactose intolerant can drink camel's milk without experiencing negative side effects; in 25 patients, it was found that camel's milk can be a viable option for those who exhibit symptoms when consuming cow's milk (27,28,29).

3.1 Specific Nutritional Benefits for Lactose-Intolerant Individuals

Health Condition	**Camel milk benefit**
Lactose Intolerance	Easy digestion without symptoms
Gastrointestinal Infections	Growth of good bacteria, antimicrobial effects
Diabetes	Natural insulin-like proteins reduce blood sugar
Autism Spectrum Disorder	Symptom reduction, improved behavior
Infectious Diseases	Treatment for tuberculosis, diarrhea, asthma, wounds

Several studies have shown that camel’s milk, in addition to its nutritional value, has several benefits in human health due to the presence of bioactive substances, such as vitamins, lactoferrin and immunoglobulins (30). According to the findings of a study conducted by Cardoso et al. on 25 people with lactose intolerance, camel milk is a good choice for these individuals. Because camel milk contains more L-lactate than cow milk, which contains more D-lactate, lactose-intolerant people digest it more quickly. Colon and gastrointestinal health are improved by lactic acid bacteria that are isolated from camel milk. Alpha-lactalbumin, casein, glycomicropeptides, antimicrobial peptides, and lactoferrin macropeptides in camel milk all promote the development and growth of bifidobacteria and guard against bacterial infections of the gastrointestinal tract.(31,32,33,34)

3.1.1 Treatment of certain diseases

Indeed, fresh and fermented camel milk is reported to be a potential treatment for several diseases such as dropsy, tuberculosis, asthma, jaundice and leishmaniasis. It is also recommended for diarrhea, constipation and wounds [35,36]. It can even be used to improve ovulation in women.

3.1.2 Immune boosting

The immune system enhancement capacity makes camel milk viewing different from other products. The beneficial effects of camel milk make it appropriate for managing sicknesses with immune system involvement such as sclerosis and crohn's infections. The anti-inflammatory and anti-apoptotic properties of camel milk combined with its antioxidant effects have been discovered to reduce alcoholic liver injury based on recent research. [37].

3.1.3 Beneficial for children health

Children with autism spectrum disorder (ASD) can also benefit greatly from camel milk. In fact, the autistic children's health significantly improved after consuming camel milk. Autistic youngsters become less destructive and more productive as a result of a notable decrease in ASD symptoms. In other instances, the autistic behavior vanished entirely.[38].

3.1.4 Camel Milk and Diabetes

approximately ¾ of the population of the world is unable to utilize allopathic medication for diseases. Hence, they depend upon natural products. Type 1 diabetes is one of the most prevalent metabolic disorders of human beings leading to complications. Camel milk's insulin-like proteins don't get destroyed in the stomach, and this can be an appropriate substitute for insulin. The fat micelles shield the insulin and deliver it to the blood in diabetic conditions. Scientists at Agrawal et al have measured insulin levels in camel milk reaching 52 U/L which both minimizes blood sugar levels and decreases insulin needs and insulin resistance in patients with diabetes. Bioactive elements present in raw camel milk demonstrate immune-modulatory characteristics that affect both β-cell functions and insulin receptor response in insulin-sensitive tissues. The insulin levels of type 1 patients will increase. Daily consumption of camel milk provides approximately sixty percent of required insulin to patients. (39,40,41,42,43).

4. Advantages of camel milk

There is not any query that each one forms of milk from cows, goats, camels, horses, or different animals are properly for human fitness and offer the frame with vitamins like proteins, fats, minerals, and nutrients similarly to water. This differentiation is primarily based totally on technological know-how as opposed to character human possibilities or tastes. The benefits of camel milk and goat milk over the broadly ate up cow milk round the sector cause them to superior.

- The water content in camel milk amounts to 90% from camel milk components while cow's milk holds a different level of water composition.
- Secondly camel milk contains lower cholesterol levels because it has 40% less saturated fatty acids and carries healthy unsaturated fatty acids and cholesterol along with fat for reducing obesity and cancer risk.
- The B vitamin group and vitamin C occur at higher concentrations in camel milk compared to any other type of animal milk available in the market.
- The mineral composition of camel milk exceeds cow's milk in terms of iron content together with calcium content and potassium content and selenium content. The iron quantity present in camel milk exceeds the iron content of cow's milk by ten times.

- A large number of people avoid developing milk allergies because camel milk contains lower levels of cow milk proteins.
- Camel milk contains less lactose thus it avoids causing (lactose intolerance) that often leads to flatulence increased intestinal gas and indigestion in individuals who consume cow's milk.
- Camel milk features reduced casein proteins than cow's milk therefore it creates milk curd without causing stomach distress and enables easier digestion. (44)

5. Availability, Challenges, and Acceptance

Camel milk has the critical role in generating food and rural economic stability in north and east Africa, central Asia, and the subcontinent of India. Today, the consumption of camel milk is rising in all these regions primarily among the inhabitants of urban towns. Reports show that it is becoming a norm to find camel milk marketing and consumption in major cities and towns across Africa where camels do not exist. Besides, due to its claimed medicinal value, demand on camel milk is increasing in recent years among consumers in Europe and North America. Due to this, camel milk is sold at very high prices. (45,46)

Camel milk is mostly drunk either fresh or after it naturally ferments to sour in pastoral camel herding societies. The gross composition of camel milk is comparable to that of cow milk. The molecular makeup, distribution, and relative composition of the milk's constituents, however, are different from those of bovine milk. As a result, it is said to be challenging to process camel milk and manufacture dairy products like cheese, yoghurt, and butter using the same technology as dairy products made from cow's milk. When they are produced, they are frequently of lower quality. However, scientific evidence suggests that camel milk could be turned into products by optimizing the processing conditions **(46,47,48)**

Quality control and market expansion are hampered by the camel milk industry's present major food hygiene and government support issues. Many potential solutions were put forth to address these issues, including the use of solar-powered cold chains, the requirement that producers receive adequate training in food safety and hygiene, and the need for infrastructure and climate resilience investments to ensure the camel milk industry's long-term viability. **(49)**

Traditional medicine practitioners have used camel milk as a treatment approach for various human diseases so scientific interest in this milk product and its products grows steadily because of its proven nutritional value and health benefits. Different bioactive elements present in camel milk contribute to both disease prevention and treatment according to the accepted therapeutic value of this milk. **(50)**

Conclusion

Long overlooked and restricted by culture, camel milk is now more widely acknowledged for its remarkable nutritional profile and special health advantages, especially for those who are lactose intolerant. Camel milk is more digestible and less likely to cause negative gastrointestinal reactions in sensitive people since it has different protein structures and lower lactose levels than regular cow's milk. Its abundance of bioactive substances, including immunoglobulins, lysozyme, lactoferrin, and insulin-like proteins, also supports its potential therapeutic use in the treatment of diabetes, allergies, and inflammatory gastrointestinal disorders.

The usefulness of camel milk as a functional food with a variety of uses in contemporary nutrition therapy is highlighted by this review. However, due to gaps in extensive clinical research, cultural unfamiliarity, and limited availability, its full potential is still largely unrealized. There is an urgent need for more knowledge, additional scientific validation, and improved accessibility to camel milk-based products worldwide in order to close this gap. Adopting camel milk as a common food choice could help people who are lactose intolerant as well as promote more sustainable and inclusive nutrition solutions globally.

To sum up, camel milk is an amazing yet frequently disregarded superfood that is especially good for people who are lactose intolerant. It is a potent functional meal due to its distinct nutritional profile, which includes high concentrations of digestible proteins, healthy fats, vitamins (particularly niacin and vitamin C), vital minerals, and bioactive substances. A natural substitute for people with dairy sensitivity, camel milk's decreased lactose level and advantageous protein structure improve its digestion and lessen allergic reactions. Its promising significance in modern nutrition and medicine is further highlighted by its potential therapeutic effects, which range from immune support and enhanced gastrointestinal health to managing diabetes and helping children with autism. Due to its significant health benefits, camel milk merits re-evaluation and inclusion in diets across the globe as interest in functional foods increases.

References:

Al Kanhal HA. Compositional, technological and nutritional aspects of dromedary camel milk. International Dairy Journal. 2010 Dec 1;20(12):811-21

Abdelazez A, Abd-elmotaal H, Abady G. Exploring the potential of camel milk as a functional food: physicochemical characteristics, bioactive components, innovative therapeutic applications, and development opportunities analysis. Food Materials Research. 2024;4(1).

Omar A, Harbourne N, Oruna-Concha MJ. 2018. Effects of industrial processing methods on camel skimmed milk properties. International Dairy Journal 84:15−22

Habtegebriel H, Wawire M, Gaukel V, Taboada ML. 2020. Comparison of the viscosity of camel milk with model milk systems in relation to their atomization properties. Journal of food science 85:3459−66

Ait El Alia O, Zine-Eddine Y, Chaji S, Boukrouh S, Boutoial K, Faye B. Global camel milk industry: A comprehensive overview of production, consumption trends, market evolution, and value chain efficiency. Small Ruminant Research. 2025 Jan 11:107441.

Singh R, Mal G, Kumar D, Patil NV, Pathak KM. Camel milk: an important natural adjuvant. Agricultural research. 2017 Dec;6:327-40.

Mehaia MA, Hablas MA, Abdel-Rahman KM, El-Mougy SA (1995) Milk composition of Majaheim, Wadah and Hamra camels in Saudi Arabia. Food Chem 52:115–122

Omer RH, Eltinay AH (2009) Changes in chemical composition of camel's raw milk during storage. Pak J Nutr 8:607–610

Raghvendar S, Shukla S, Sahani MS (2004) Chemical and physico-chemical properties of camel milk at different stages of lactation. Saving the camel and peoples' livelihoods. In: Proceedings of an international conference held on 23–25 November 2004 in Sadri. LokhitPashu-PalakSansthan, Sadri, Rajasthan, India, p 37

Khaskheli M, Arain MA, Chaudhry S, Soomro AH, Qureshi TA (2005) Physico-chemical quality of camel milk. J Agric Soc Sci 2:164–166

Abbas S. Physico-Chemical Analysis And Composition Of Camel Milk. The International Research Journal. 2013 Jun;2(2):84–98

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

agil R. Camels and camel milk book. Food and Agriculture Organization of the United Nations; pp. 17–18. Available from

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

Shamsia SM. Nutritional and therapeutic properties of camel and human milks. International Journal of Genetics and Molecular Biology. 2009;1(2):52–8

Zibaee S, Yousefi M, Taghipour A, Kiani MA, Noras MR. Nutritional and therapeutic characteristics of camel milk in children: a systematic review. Electronic physician. 2015 Nov 20;7(7):1523.

Al Kanhal HA. Compositional, technological and nutritional aspects of dromedary camel milk. International Dairy Journal. 2010 Dec 1;20(12):811-21.

Fguiri I, Ziadi M, Atigui M, Ayeb N, Arroum S, et al. 2016. Isolation and characterisation of lactic acid bacteria strains from raw camel milk for potential use in the production of fermented Tunisian dairy products. International Journal of Dairy Technology 69:103−13

Baig D, Sabikhi L, Khetra Y, Shelke PA. 2022. Technological challenges in production of camel milk cheese and ways to overcome them – A review. International Dairy Journal 129:105344

Alavi F, Salami M, Emam-Djomeh Z, Mohammadian M. 2017. Nutraceutical properties of camel milk. In Nutrients in Dairy and their Implications on Health and Disease, ed. Watson RR, Collier RJ, VR Preedy VR. an Diego, California, USA: Academic Press. pp. 451-68. doi: 10.1016/B978-0-12-809762-5.00036-X

Fguiri I, Ziadi M, Atigui M, Ayeb N, Arroum S, et al. 2016. Isolation and characterisation of lactic acid bacteria strains from raw camel milk for potential use in the production of fermented Tunisian dairy products. International Journal of Dairy Technology 69:103−13

Li Y, Liu L, Fan Y, Liu W, Yang Q, Wen W, Li W, Hao L, Zou H, Xieermaola Y, Cao L. Quality characteristics and nutrient contents of Bactrian camel milk as determined by mid-infrared spectroscopy. International Journal of Dairy Technology. 2024 May;77(2):304-12.

Abdelazez A, Abd-elmotaal H, Abady G. Exploring the potential of camel milk as a functional food: physicochemical characteristics, bioactive components, innovative therapeutic applications, and development opportunities analysis. Food Materials Research. 2024;4(1).

Roy D, Ye A, Moughan PJ, Singh H. Composition, structure, and digestive dynamics of milk from different species—A review. Frontiers in Nutrition. 2020 Oct 6;7:577759.

Li S, Ayyash M, Ye A, Singh H. Dynamic in vitro gastric digestion behaviour of camel milk. International Dairy Journal. 2023 Aug 1;143:105670.

Ali AH, Li S, Liu SQ, Gan RY, Li HB, Kamal-Eldin A, Ayyash M. Invited review: Camel milk and gut health—Understanding digestibility and the effect on gut microbiota. Journal of Dairy Science. 2024 May 1;107(5):2573-85.

Al Kanhal HA. Compositional, technological and nutritional aspects of dromedary camel milk. International Dairy Journal. 2010 Dec 1;20(12):811-21.

Cardoso RR, Santos RM, Cardoso CR, Carvalho MO. Consumption of camel's milk by patients intolerant to lactose. A preliminary study. Revista Alergia de Mexico. 2010 Jan 1;57(1).

Zibaee S, Yousefi M, Taghipour A, Kiani MA, Noras MR. Nutritional and therapeutic characteristics of camel milk in children: a systematic review. Electronic physician. 2015 Nov 20;7(7):1523.

Al haj OA, Al Kanhal HA (2010) Compositional, technological, and nutritional aspects of dromedary camel milk. Int Dairy J 20(12): 811

Cardoso RR, Santos RM, Cardoso CR, Carvalho MO. Consumption of camel's milk by patient's intolerant to lactose. A preliminary study. Revista Alergia Mexico. 2010; 57(1), 26-32

Mullaicharam AR. A review on medicinal properties of camel milk. The World J Pharmac Sci. 2014; 2(3), 237-242.

Baubekova ASA, Kalimbetovaa SH, Akhmetsadykova O, Konuspayeva Faye B. Comparison of D. Lactate and L. lactate content in cow and camel milk. In: Proceeding of 4th Conference of ISO CARD, " Silk Road Camel: The Camelids, Main Stakes for Sustainable Development," June 8-12, 2015 Almaty, K., G. Konuspayeva. (Eds.), Special Issue Sci Prac J Vet. 2015; 2, Pp. 397-398

Badr G, Ramadan NK, Sayed LH. Why whey? Camel whey protein is a new dietary approach to the management of free radicals and for the treatment of different health disorders. Iranian J Basic Medical Sci. 2017; 20, 338–49.

El-Agamy EI (2009) Bioactive components in camel milk. Bioact Componentsin Milk Dairy Prod 107: 159.

Shalash MR (1979) The production and utilization of camel milk. In: The Camelid An all-purpose animal in: Proceeding of Khartoum Workshop on Camels. Pp: 196-208.

Sumaira AMS, Solangi GA, Anwar I, Kalwar Q (2020) Composition and Beneficial Impact of Camel Milk on Human Health. Punjab Univ J Zool 35(2):179-189

Izadi A, Khedmat L, Mojtahedi SY (2019) Nutritional and therapeutic perspectives of camel milk and its protein hydrolysates: A review on versatile biofunctional properties. J Funct Foods 60: 103441.

Shori AB. Camel milk as a potential therapy for controlling diabetes and its complications: A review of in vivo studies. J. Food Drug Anal. 2015; 23, 609-618

Mohamad RH, Zekry ZK, Al-Mehdar HA, Salama O, El-Shaieb SE, El- Basmy AA. Camel milk as an adjuvant therapy for treating type 1 diabetes: verification of a traditional ethnomedical practice. J Med Food. 2009; 12(2), 461–5

Shamsia SM. Nutritional and therapeutic properties of camel and human milk. Int Journal Genet Mol Biol. 2009;1, 52.

Agrawal RP, Swami SC, Beniwal R, Kochar DK, Sahani MS, Tuteja FC. Effect of camel milk on glycemic control, lipid profile, and diabetes quality life in type 1 diabetes: a randomized prospective controlled crossover study. Indian J Anim Sci. 2003; 73(10),1105–10

Mohammadabadi T, Jain R, Rehman AU, Al Juwarey M, Singh M. Camel Milk; A Nutritious Superfood for Health Complications. Milk Science International-Milchwissenschaft. 2023 Jul 24;76(6).

AL-Moosawi Z, Almahdawi M, Al-Charak A. Camel milk as an integrated food and its physical and chemical properties with therapeutic characteristics. Int J Vet Sci Anim Husb. 2023;8:90-6.

Mbogo EN, Field CR, Ngeiywa KJ, Abey KA. Origin and uses of camels. Chapter 1. Camel manual for service providers. 2012:1-0.

Seifu E. Camel milk products: innovations, limitations and opportunities. Food Production, Processing and Nutrition. 2023 Mar 4;5(1):15.

Abdelgadir WS, Ahmed TK, Dirar HA. The traditional fermented milk products of the Sudan. International Journal of Food Microbiology. 1998 Oct 20;44(1-2):1-3.

Berhe T, Seifu E, Ipsen R, Kurtu MY, Hansen EB. Processing challenges and opportunities of camel dairy products. International journal of food science. 2017;2017(1):9061757.

Ait El Alia O, Zine-Eddine Y, Chaji S, Boukrouh S, Boutoial K, Faye B. Global camel milk industry: A comprehensive overview of production, consumption trends, market evolution, and value chain efficiency. Small Ruminant Research. 2025 Jan 11:107441.

Mihic T, Rainkie D, Wilby KJ, Pawluk SA. The therapeutic effects of camel milk: a systematic review of animal and human trials. Journal of evidence-based complementary & alternative medicine. 2016 Oct;21(4):NP110-26.