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REVIEW ARTICLE

A Critical Review on the Role of Camel Milk in Multiple Health Outcomes

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Abstract

Camel milk has been demonstrated to be effective in treating a broad range of illnesses. Camel's milk is regarded to have therapeutic properties because of its unique composition. Some people consider camel milk to be a precious commodity. White camel milk is made by combining fat and water. Several clinical studies have shown that camel's milk is effective in treating a broad variety of diseases, including chronic ones. Most of the medicinal advantages of camel milk are included in this study. Camel Milk ingredients and qualities are similar to those found in mother's milk, making it superior than cow's milk. Insulin-like and protective proteins are found in abundance, along with lactose, which is the primary carbohydrate. It has anti-tumor qualities, and the robust immune system components assist combat disorders, including diabetes, autism, and diarrhea. It has been used by Nomads and Bedouins (Arabian tribals) for millennia because of these properties. The main objective of this review article is to demonstrate its various pharmacological roles. Camel's milk is regarded as a vast medicinal property, as it contains a unique composition of bioactive moieties like lactose, proteins (Lactoferrin, Lactoperoxidase, Insulin, Casein), vitamins (A, B1, B2, C, D, E), minerals (Calcium, phosphorus, magnesium, iron, zinc and copper) carbohydrates etc. Most of the medicinal advantages of camel milk are covered in this paper, like its role in the management of autism, Crohn's disease, allergic conditions, Hepatitis B and C, as antiviral and antibacterial agent. Hence, this study was planned to collect the updated latest information regarding use of camel's milk, which will be very beneficial in the field of medicines and managing various ailments for the benefit of mankind.

Keywords: Camel's Milk, Chronic Disease, Protein, Therapeutic Properties

1. Introduction

Many cultures in the Middle East, Asia, and Africa have used camel's milk as a therapeutic supplement. Only lately have the medicinal and therapeutic benefits of camel milk and its contents been studied, according to recent scientific studies[1]. Camel's milk has the greatest resemblance to human breast milk in terms of composition. Studying the medicinal and therapeutic properties of camel's milk has shown a number of health advantages. Is an aromatic and flavorful black, milky liquid that originates from camels[2]. According to their food and water supply, camel's milk might have a vastly different flavor. Since it smelled bad and was slathered in butter or froth, most people found camel milk repulsive[3]. In addition to 11.9 per cent solids, Camel milk has a protein content of 3.1%, a lactose content of 4.4%, and a mineral content of 0.79[1,2]. Depending on the quantity of water accessible to the camels, the moisture content of camel milk ranges from 84 to 90 percent. Other conditions that Camel's milk has shown to help with include the treatment of include the therapy for rheumatoid arthritis and diabetes[2]. It has also been shown to help treat hepatitis and Crohn's disease. In north-east Africa, and the Democratic Republic of the Congo, more

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than 60 per cent of the one-humped dromedary (*Camelus sylvestris*) population survives, whereas only 11 per cent of the population resides in the freezing deserts in Asia. According to the Food and Agriculture Organization (FAO), there are an estimated 25.89 million of them. Ethiopia's camel herds are the third largest in the world, after only those of Somalia and Sudan[1].

They have long been used for medical reasons and as a source of food and transportation in the deserts of Asia and Africa. In arid and harsh settings, camel milk output outperforms that of any domestic cow species[3]. Lactation may last anywhere from 12 to 18 months[2], when a camel may generate up to 10 kilos of milk every day[4]. Ethiopia produces the second most camel milk in the world, behind Somalia, with its 2.4 million camels. The annual production of camel milk is around 50,000 metric tonnes in Ethiopia, according to this estimate[5].

In camel milk, lactoferrin and lactoperoxidase protect against oxidative stress, which may lead to cancer and heart disease. Dropsy and jaundice are associated to "kala-azar," camel milk, which may also aid with asthma and leishmaniasis treatment[5,6].

Camel milk has been linked to allergy responses in lactose-intolerant individuals due to its low-casein concentration and lack lactoglobulin[7]. Despite the existence of insulin-like and protective proteins, the anti-tumor properties make it a suitable treatment for a wide range of disorders, including diabetes[8,9]. Camel milk is a great option if you suffer from stomach ulcers since it has been shown to have powerful anti-cancer and anti-thrombotic effects[10]. Recent research has shown that camel milk has antioxidative qualities, antibacterial, antiviral, and antifungal activity, antihepatitic treatment, hypoglycemic activity, anticancer, antiaging prevention, and anti-autoimmune disease medicine, as well as cosmetics and detergents[1,11,12].

There is a dearth of knowledge on the usefulness and application of camel milk since the camel is a scientifically extinct species.

2. Camel Milk Products and Processing

2.1 Butter

Butter isn't a common product made from camel milk, and it's difficult to produce using the same industrial methods as butter made from cow milk. The high melting point of camel milk lipids (41-42 °C) makes churning the cream at the temperatures required for churning cow milk (8-12 °C) difficult. In comparison to butter made from cow›s milk. Camel milk butter has a bright white colour and a thicker, more viscous viscosity, with a neutral flavour and scent[13]. Nomads make butter from camel milk in a variety of methods. Butter is utilised for both scientific and culinary purposes. Kenya, instead of North-Japanese-Kenya, they employ ways in Kenya to acquire the most effective tiny amount of camel milk fats possible. A few rocks are heated over an open fire, and the jar containing uncooked milk is placed inside. Fat drops are formed and appear on the surface. Milk is churned after cooling until the fat drops turn into butter granules. According to Yagil[14], butter is made in the Sahara by keeping camel milk in goatskin at room temperature for 12 hrs with the purpose of fermenting it. The goatskin is then inflated with air and closed, then swung back and forth quickly on a tent pole. At the end of the churning process, a small amount of bloodless water is added, allowing butter to develop[13], conducted an experiment in commercial butter manufacture in rural north-central Kenya. Milk was heated to 65°C before being centrifuged. The percentage of fats in cream was set at 20-30 %. It was then churned at temperatures ranging from 15-36 °C. At room temperature of 27°C, butter was flushed with water after churning. The best results were obtained by churning cream with 22.5 per cent fat and 25°C. The churning process took 11 mins.

2.2 Cheese

Camel Milk has a variety of chemicals that aid in the fight against disease-causing germs. Lactoferrin and immunoglobulins, which provide the body with a strong immune system, are two of the most common compounds found in camel milk. Lactoferrin possesses antibacterial, antifungal, anti-inflammatory, antioxidant, and antiviral characteristics, which help to prevent the spread of bacteria and viruses, making the body more susceptible to colds, coughs, and fevers. Camel milk is also high in antioxidants, which help your body fight free radical damage. Despite the fact that cow milk contains proteins and minerals, it is not necessarily as abundant as camel milk. It contains magnesium, zinc, and other minerals, although the amount found in its kilometers is less than that[14].

2.3 Soft Cheese

Calcium chloride (10-15 g/100 kg) was added after skimming and thermal processing were used to make ready milk. After the temperature of the milk was dropped to 35°C and the pH to 6.2-6.8, this was observed using a combination of mesophilic starter and clotting agent. Curdling takes anywhere from 10 to 30 mins. The curd was reduced to 1-4 centimeter grain size and left in the whey for 30 to 90 mins. Every 10 mins, the cheese grains are softly swirled for 60 seconds. The curd was manually placed into the moulds, where it remained for six hrs at 26-28 °C and then for another 18-20 hrs at 16-22 °C. To become mature, the cheese inside the moulds must be grown a total of five times during that time. It is salted by either dry-salting on the floor or brining for 10 to 30 mins. Maturation can take anywhere from 2 to 8 weeks, depending on the water content of the material and the development of microorganisms on the floor or in the cheese. The ripening room must have a temperature of 12-14 °C and a humidity of 90-95 per cent. Three smooth cheese types can be distinguished based on the prevalent form of cheese microorganisms during ripening. Smooth cheeses with the floor mould *Penicillium camemberti*, and smooth cheeses with floor micro-organisms smooth cheeses with the interior mould *Penicillium roqueforti* and *Brevibacterium linens*.

2.4 Hard Cheese

Whole or semi-skimmed milk is thermally processed through thermisation or low-warmness pasteurisation earlier than including calcium chloride. Mesophilic subculture is utilized in the quantity of 0.5-1.5 g/100 kg of milk. The temperature of milk should be reduced to 30- 33 °C, and pH 6.4-6.8 earlier than including the clotting agent (4-8 g/100 kg of milk). Curdling time takes 10 to 30 mins. The curd is reducing into grains of 0.5-1.0 cm in length and for the duration of 1/2 of hr is slowly stirred for 60 s each 10 mins. Between 20-60 % of whey is changed with the identical quantity of po- desk water of 30-33°C. Pre-urgent is finished in timber or metallic moulds for 10 to 20 mins after which pressed for two to six hrs at 22-26 °C. It is salted through brining or dry salting at the surface. Ripening lasts for 15 to 45days at 12-16 °C and 90-95 % humidity. Cheese yield quantities to six-10 kg/100 kg of milk for the duration of studies in Kenya produced a semi-tough cheese from camel milk with the subsequent manufacturing technology[15,16]. The milk became thermally processed at 65°C/30 min on open hearthplace after which cooled to 35°C. After including 5% of mesophilic subculture and 0.25 g/L of citric acid a pH of 5.6-5.7 became reached, clotting agent became added, the curd reduces after forty mins. The curd-whey combination became stirred for 20-30 min at 45°C. The curd became located into cheese cloth, pressed and positioned right into a 10% NaCl brine. Subsequently, the cheese ripened at 18°C and relative humidity of 95%. The cheese had a first-rate cross-phase, and flavor became similar with Blue Cheese or Limburger. After three weeks of garage at room temperature the flavor has become bitter. Pre-urgent is finished in wood or metal moulds for 10 to 20 mins before being pressed at 22-26 °C for two to six hrs. It is salted at the surface via brining or dry salting. Ripening takes 15 to 45 days at 12-16 °C and 90-95 per cent humidity. Cheese yields six to ten kilograms per hundred kilograms of milk[15]. They generated a semi-tough cheese from camel milk using later production technologies during their research in Kenya. The milk was thermally treated at 65°C for 30 mins on an open fire, then cooled to 35°C. After incorporating 5% mesophilic cultures and 0.25 g/L citric acid, a pH of 5.6-5.7 was achieved, and the clotting agent was introduced. After 40 mins, the curd has reduced at 45°C, the curd-whey mixture was mixed for 20-30 mins. The curd was wrapped in cheese cloth, squeezed, and placed in a 10% sodium chloride brine. The cheese then matured at 18°C and 95 per cent relative humidity. The cross-phase was excellent, and the flavour was similar to Blue Cheese or Limburger. The flavour has intensified after three weeks in the garage at room temperature[16].

3. Chemical Composition of Camel Milk

Color and scent are typically white, however salty camel's milk has been reported[17]. Because of the fine homogenization of lipids throughout the milk, the milk has an opaque white appearance and a particular flavor that varies according to the kind of forage used and the availability of drinking water. If the pH is 4.95, it can withstand it because of its lower density and greater buffering capacity[8].

To some degree, the camel's physiological stage, feeding circumstances, seasonal or physiological fluctuations, and genetics all affect its milk's composition, as do the majority of specialists[18]. Camel milk contains 97% water, followed

Table 1. Chemical composition of milk of 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	88-89	1.1-1.3	3.3-4.7	0.2-0.3	6.8-7.0
Source[19]					

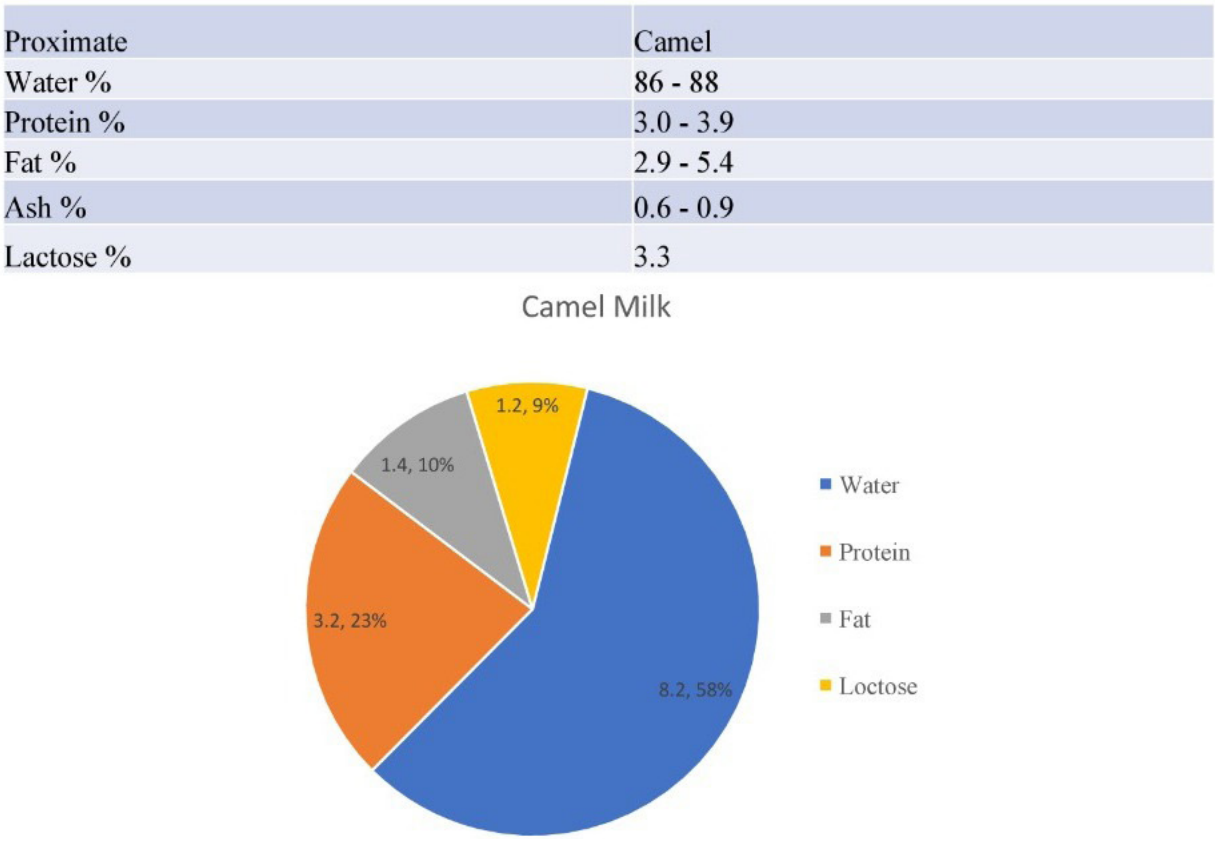

Figure 1. Percentage of various camel milk compositions.

by 3.4% protein, 3.5% fat, 4.4% lactose, and 0.79 per cent ash as shown in Figure 1 and Table 1[19].

3.1 Water

Camel milk is mostly water-based. Camel milk has more water when it is dehydrated than other milks. When water is readily available, it contains 86% water, but, when water is restricted, the water content jumps to 91%. This may be used to rehydrate people and dehydrate cattle in circumstances when clean water is unavailable[3]. The milk of the dehydrated camel has more water because ADH production is increased[3].

3.2 Proteins

The composition and characteristics of the molecules that make up milk proteins are quite diverse[4]. Protein content

in dromedary camel milk is in the range of 3–3–9 per cent. Casein is the most common and most abundant of the milk proteins, accounting for the vast majority of all[20]. She says camel milk has more protein (particularly casein) than human milk and less whey[21].

Camel milk has a much of casein, a kind of protein[22]. About 1.63-2.76 percent casein protein is found in the milk of dromedary camel, S1 and S2 proteins are the basic components in the casein protein[23]. A wide diversity of animal species display variation in these proteins. There is no S1-fraction in human milk, which is the root cause of most milk protein allergy symptoms. However, the -fraction is abundant. The total casein content of cow and buffalo milk is 38.4 per cent and 30.22 percent, respectively[24]. Cow's milk proteins may cause allergic reactions in those who are sensitive to milk proteins (MPA). S1-CN accounts for 65 per cent of all casein in this sample. Because it hydrolyzes more slowly in camel milk than in cow milk, s-CN is less likely to produce an allergic response in newborns[25].

It is also important to note that whey is the only kind of milk protein that is found in camel milk. 0.63 to 0.80 per cent of whey protein is found in dromedary camel milk[22]. Though lactoglobulin is found in camel milk at small levels, lactoalbumin has taken its place. In terms of whey protein, only 25% of cow's milk comprises lactalbumin, and 50% of it is lactoglobulin[17]. Immunoglobulins, lactoferrin, peptidoglycans, and recognition proteins may all be found in camel milk whey protein[26].

Breast cancer seems to be inhibited, and the host immune system is stimulated by Peptidoglycan Recognition Protein (PGRP), a protein from camel milk and one of the most effective ways to improve your immune system is to use it. Clinical investigations show that it has a protective effect against breast cancer[8]. Breast cancer may be inhibited and the host's immune system boosted by PGRP, a protein in camel milk[4]. A healthy immune system is boosted, and bacteria and other microorganisms are wiped off successfully. Clinical investigations show that it has a protective effect against breast cancer[8].

Metal cations (ideally Fe^{3+}) may be covalently linked to the binding sites formed by this molecule. In addition to its role in transporting and storing iron, lactoferrin is also an antioxidant protein. By comparison, camel milk has the most lactoferrin of any of the other four types of milk (0.22 $mg.mL^{-1}$). Lactoferrin levels (2.3 $g.L^{-1}$) peaked two days after delivery, according to research by El-Hatmi and colleagues[27]. Increased Lactoferrin concentration in camel milk inhibits bacterial multiplication and pathogen invasion[28].

Antibacterial, growth-promoting, and anticancer characteristics are among Lactoperodoroase's contributions to the non-immune host defence system[29]. *E. coli*, *Salmonella* and *Pseudomonas* are among the bacteria that Lactoperoxidase is most effective against. While cow and human milk also have significant concentrations of the lysozyme protein, camel milk has the greatest concentration. Human milk has comparable concentrations of the antibacterial enzyme Nagase[8]. In camel milk, Igs are crucial for the milk's ability to fight and remove bacterial infections. Unlike human Igs, Camel Igs have a distinct ability to enter tissue and cell membranes. Because of its microscopic size (one-tenth that of human antibodies), it is readily absorbed into the digestive tract of the nursing camel[2]. Immunoglobulin G (IgG) is found in camel milk at the highest concentration of any animal or human milk.

3.3 Fats

For example, if Daroma camel milk comes from thirsty animals, the fat level may drop to 1.1 per cent[18,30]. Polyunsaturated and omega-3 fatty acids make up the majority of the fat in camel milk, which has just 2% fat content. The fat globules in buffalo milk had an average diameter of 8.7 m, whereas those in camel and goat milk had smaller average diameters[31]. Enzymes may have an easier time accessing fat globules if the fluid's milk fat is dispersed evenly Sum Frequency Generations (SFGs). There is evidence that humans are better able to metabolise milk from cows, goats, and camels[32]. Compared to bovine milk, camel milk has a greater percentage of long-chain fatty acids (96.4%) (72.4%).

Camel milk fat had a higher rise in cholesterol (25.6 mg) than cow milk fat (100 g^{-1}) (34.5 mg) in the milk fat[18]. Compared to cow milk, camel's milk fat may include more carotene and short-chain fatty acids.

About 95% of the milk fat globule membrane cholesterol is found in the membrane of the Milk Fat Globule Membrane (MFGM). In terms of surface area for MFGM, (SFGs) have the most. As a result, milk with a high SFG concentration has a higher cholesterol content. Compared to milk from cows, goats, sheep, and buffalo, camel milk contains six to eight times as many Short-Chain Fatty Acids (SCFA)[4]. Milk from camels includes an extensive array of fatty acids, including butyric and caproic

acids, caprylic and oleic acids, arachidic and arachidonic acids, as well as stearic and oleic acids[33].

3.4 Carbohydrate

About 3.3 to 5.80 % of the total carbohydrates in camel milk come from lactose sugar, the predominant source (Table 1). Desert camel lactose levels may vary greatly depending on the kind of vegetation they consume and the temperature. Camel physiology necessitates the consumption of salt-rich plants like Salsa, Acacia, and Artiplex. According to dromedary breeds from throughout the world, there has been minimal change in lactose content. Lactose sensitivity in humans is not indicated by any human physiological or biochemical markers (milk sugar).

3.5 Minerals

Mineral content in dromedary camel milk ranges from 60 to 100 percent. Depending on the kind of food, the breed, and the amount of water consumed, mineral levels might vary greatly. Calcium, phosphorus, magnesium, iron, zinc and copper are all found in camel milk, as well as sodium and potassium[34]. Dromedary camel milk contains 100 grammes of zinc, iron, sodium, potassium, and calcium per 100 grams (mg)[17].

3.6 Vitamins and Electrolytes

In Dromedary camel milk, vitamins D, E, A and C, as well as B vitamins, may be discovered. Vitamin C levels in camel milk are three to five times higher than in cow milk, according to one study. Camel milk has 34.1 mg of vitamin C on average per serve. A total of 34.16 milligrams of L^{-1} L^{-1}. Camel milk has higher niacin levels than cow milk (B3). About 10.5 per cent ascorbic acid, 5 per cent vitamin A, 8 per cent riboflavin (B2), and 15.5% of the riboflavin (B2) Recommended Daily Intake (RDA). (RDI). When it comes to the B vitamins riboflavin (B2) and folate (F), an average adult only needs 9.5 % of the Daily Value (DV) from 250 mL (one cup) of milk to meet their daily need[35].

Milk's lower pH may be offset by its higher vitamin C content. It is possible to preserve milk for a long amount of time without it developing a thick layer of cream due to the acidity of the milk itself. Camel milk has more vitamin C than cow milk[36]. Osteoporosis patients benefit from a diet high in vitamin C and iron, which help in calcium absorption[37].

4. Therapeutic Values of Camel Milk

Bioactive components found in camel milk have been linked to health benefits as shown in Figure 2[38]. Between July 2005 and January 2006, 97.7% of residents in the woreda Babilie and Kebribeyah in Somalia's Jijiga Zone thought that camel milk was therapeutic, according to polls. Camel milk may help treat AIDS, Tuberculosis (TB), Hepatitis (HBV), and other diseases[5]. Camel milk may be used to treat a wide range of human maladies, including jaundice, malaria, and constipation, according to pastoralists cited in this article. Cannibals are said to release medicinal compounds into their milk as a result of the wide variety of plants they devour[39].

Camel milk consumption has been linked to a variety of diseases, including dropsy and jaundice, TB, and asthma[5]. Due to the high concentration of bioactive components in milk, several studies have shown that it is an essential source of nutrition and sustenance that may also give health advantages. Camel-breeding cultures believe that camel milk is especially good for curing dropsy, jaundice, and lung/spleen problems[12,40].

Apart from its antibacterial and antifungal characteristics, camel milk includes anti-inflammatory, growth-stimulating, and anti-tumor compounds such as lactoferrin (lysozyme) and lactoperoxidase (LP)[41]. Conesa and colleagues report that camel milk has anti-inflammatory properties[42]. On the other hand, immunoglobulins defend the body against infection, while LZ is a component of the basic immune system. An extra protein found in lactoferrin (LF) camel milk has been demonstrated to limit the growth of germs in the intestines.

Precursors to digestion, absorption, development, and immunity may be found in camel milk[19]. Camel milk may be stored at room temperature for a longer time than milk from other animals[43].

Camel milk's exceptional therapeutic potential for human health has enhanced its worth globally in recent years. Numerous research investigations have shown the health advantages of camel milk[11,12], including antioxidant, antibacterial, antiviral, antifungal, and anticancer properties.

4.1 Anti-Diabetic Properties of Camel Milk

Diabetes mellitus is the medical term for high blood glucose levels that persist over a lengthy period of time[2].

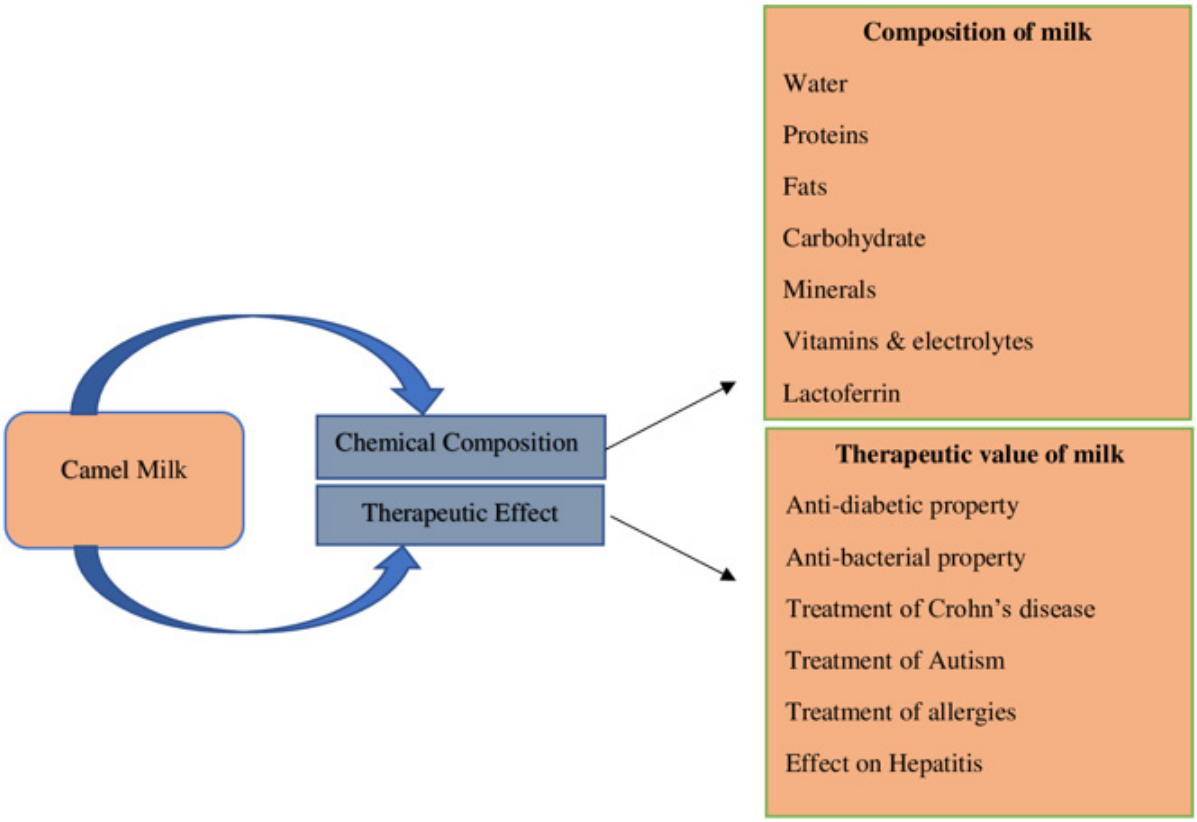

Figure 2. Schematic diagram of composition and therapeutic value of camel milk.

There are two probable reasons for beta-cell dysfunction in the pancreas, which produces insulin: an autoimmune attack or a defective insulin receptor. A deficiency of insulin results in a rise in blood and urine glucose levels. On the other hand, camel milk is to blame since it includes proteins that help in tissue healing.

Children with juvenile diabetes who had regular treatment and drank camel milk saw lower blood sugar and HbA1C levels, according to Indian experts[44]. Insulin from camel milk has a unique potential to control and influence the cell's immunological system[45]. In each ml of camel milk, there are 150 units of insulin[4]. Camel milk insulin, unlike other animal insulin, does not coagulate in the stomach's acidic environment[29]. A combination of micelles and nanoparticles helps to preserve camel insulin in the upper gastrointestinal tract from proteolysis so that it may be absorbed and distributed to the blood. The metabolic syndrome is characterized by high blood sugar, high cholesterol, and insulin resistance. Could camel milk's antioxidant properties aid protect against this syndrome (Table 1).

Insulin levels in camel milk are higher than in cow milk[45], patients with Type 1 diabetes who are having difficulty controlling their blood sugar levels and decreasing their insulin requirements may benefit from this medication, and it is considered safe and effective for this purpose[46]. Researchers found insulin-rich camel milk in the same way in a recent experiment[47]. Anti-diabetic effects of immunoglobulins and insulin-like lactoferrin have been shown in biochemical tests in camel milk. The reduced frequency of diabetes in the population may be due to the use of camel milk[45].

After a long-term investigation, camel milk was shown to be a safe and effective insulin substitute. Two categories of diabetics were created. Camel milk was given to this group in addition to their usual diet, physical exercise, and insulin injections. The levels of glucose, hemoglobin, and insulin were lower in individuals who had camel milk as compared to those who were given a placebo. In the

camel milk group, there was no need for insulin. Insulin and anti-insulin antibodies were present in identical concentrations in the blood of both groups. Camel milk has been shown to enhance glycemic control in Type 1 diabetics[46].

4.2 Anti-Bacterial and Antiviral Properties

Camel milk is higher in antibacterial enzymes lactoferrin and lactoperoxidase (LP) and protective proteins such as caseins than other ruminant milk. Camel milk has more lactoferrin and lysozyme than cow milk does[18]. The bacteriostatic and bactericidal effects of lactoferrin have been shown in scientific literature[48]. A wide range of Lactoferrin MIC values may be attributed to this variability in activity. Various investigations have shown that lactoferrin inhibits Gram-positive and Gram-negative microorganisms *in vitro*[49].

According to Benkerroum[50], *E. coli* and *L. monocytogenes* were shown to be bactericidal and bacteriostatic in colostrum and camel milk, respectively, when tested against these pathogens. Raw camel milk was shown to be more efficient in killing bacteria than cooked milk. If the milk's inhibitory capacities were impacted by heat treatment, there was insufficient evidence to rule this out completely. When LP was heated to 80°C for 40 s or 76°C for one minute, the lysozyme was completely inactivated.

Al-Majali has investigated proteins that protect against Gram-negative and Gram-positive bacteria, as well as rotaviruses[48]. As a result of their work with camel milk, the scientists were able to identify and study a variety of immune system components, including lactoperoxidase, Lysozyme, IgG, IgA, and secretory IgA. Camel milk LP was shown to have bactericidal and bacteriostatic effects on Gram-positive and Gram-negative microorganisms. A study found that immunoglobulins had little impact on bacteria, while camel milk had high amounts of antibodies against the rotavirus.

According to a certain study, camel milk may be able to cure TB. Patients with tuberculosis who have developed resistance to various therapies may benefit from camel milk as an adjuvant dietary supplement[36].

It is important to understand that Lactoferrin is an anti-inflammatory, bacteriolytic, and viricide protein. LP and other all show anti-diarrheal and antibacterial properties, as well as significant antibody titers against rotavirus in camel milk lysozyme, lactoferrin, and LP. However, substances affect the immune system[51]. Infants and toddlers under the age of five are more likely to get rotavirus infections[52]. Anti-rotavirus antibodies found in camel milk may aid in the prevention of diarrhea.

According to recent studies, camel caseins now show antibacterial capabilities. Two types of pepsin and pancreatin were found to be able to break down casein into smaller fragments with a molecular weight of less than 1 kDa. Camel milk hydrolyzed caseins' antibacterial activity was improved by proteolytic enzymes over that of the original casein. There's a good chance that this is how camel casein antibacterial pieces got out in the first place[53].

Due to the camel's superior immune system, the tiny immunoglobulins found in camel milk may enter the human circulation. Autoimmune diseases may be effectively treated using immunoglobulins, which are contained in camel milk and can be used to regenerate the immune system[54]. *E. coli* and S. aureus infections were successfully treated with camel milk antibacterial treatment in rats. Contrary to popular belief, however, camel milk has a synergistic effect with antibiotics, which allows for lower dosages while simultaneously decreasing bacterial resistance. To counteract the oxidative stress caused by *E. coli* and Staphylococcus aureus injection, camel milk supplementation was used[43].

4.3 Camel Milk for the Treatment of Crohn's Disease

A persistent inflammation of the intestines is caused by Crohn's disease, which is an autoimmune illness. Studies have revealed that camel milk, when coupled with phytoresveratrol (PGRP), has significant bactericidal capabilities, even though MAP infections may promote autoimmune illnesses such as Crohn's disease[55]. When this is done, healing takes place more quickly and effectively.

As a source of antibacterial and anti-inflammatory chemicals, camel milk is a good option. Non-pasteurized camel milk is beneficial for a variety of digestive ailment[56]. Camel milk is beneficial in the treatment of Crohn's disease, according to Shabo and his colleagues. In the treatment of tuberculosis, camel milk, which has antibacterial properties, has been utilised in conjunction with PGRP, indicating that the two work well together. Antibodies aid in the recovery of the immune system's function[6].

4.4 Camel Milk for Treatment Autism

Autism Spectrum Disorders (ASDs) are a wide range of conditions that impact the development and growth of the brain. Casein amino acids are formed in the digestive system of many autistic people by an enzyme that breaks down milk protein casein. Beta-casein and beta-lactoglobulin are the primary sources of casomorphine. Adverse effects on cognition and behaviour are common because of opioid-induced brain damage[11].

The most obvious signs in the brain are induced by beta-casein and beta-lactoglobulin, both of which are found in cow's milk. Rather of that, a very potent opioid called casomorphine is synthesised[51]. This medicine may elicit symptoms similar to those of an autistic person.

Camel milk has no casomorphine-producing caseins, and so does not cause symptoms[55]. Camel milk contains immunoglobulins necessary for immune system development, as well as nutritional benefits for brain development. Numerous studies have also connected camel milk to a decrease in autistic symptoms[12].

Camel milk has been shown to minimize the symptoms of autism in youngsters, along with a host of other physical and cognitive abilities[47]. Baby camel milk consumers' behavior and nutritional status increased dramatically, as noted by Abbas[17]. Before and two weeks after camel milk delivery, plasma glutathione, superoxide dismutase, and myeloperoxidase levels were measured using the ELISA technique. Camel milk intake resulted in an increase in every parameter measured. Based on the improved CARS[4], The decrease in ROS levels and rise in autistic behaviour may be related, and we believe that camel milk plays a role.

4.5 Treatment for Allergies

Lactoglobulin, a milk protein present in cow and mare milk, causes allergic reactions in humans. Fresh milk, on the other hand, contains this allergen-inducing protein. Casein, a protein found in cow's milk, may cause allergic responses in certain individuals. Camel milk has casein that is structurally unique from that found in cow milk. IgEs and monoclonal antibodies may not be able to recognize camel proteins because of evolutionary differences between them. Children with serious food allergies who drank camel milk had a significant reduction in their symptoms. Camel milk may be beneficial for young children with dietary allergies, observed no immunological link between camel and cow milk proteins[57]. This is a requirement of clinical practice. Camel milk may be a feasible source of protein for youngsters who are allergic to cow's milk.

When it comes to cross-reactions between cow milk allergens in buffalo milk proteins and those in goat milk, sheep milk, or horse milk, they did not identify any evidence of such cross-reactions. Due to the absence of lactoglobulin[58]. Using human milk instead of camel milk is an option.

Immunoglobulins similar to those found in breast milk are present in camel milk, which helps future food consumers avoid allergic reactions and strengthens their immune systems. Children with severe food allergies may benefit from drinking camel milk. Rapid onset and long-term effects are both present here.

Milk from camels may be substituted for lactose-intolerant people[59]. Humans can readily absorb camel milk's lactose content. Lactose intolerant individuals may ingest camel milk without adverse effects[28].

Camel milk has anti-cancer, anti-tumor, and ulcer-healing properties[28]. Anti-cancer properties of lactoferrin have been shown in vitro. Camel milk's lactoferrin, a main iron-binding protein, has been shown to suppress cancer growth by 56% in laboratory studies[60]. As shown by Korashy and colleagues[9], camel milk causes apoptosis and oxidative stress in HepG2 and MCF7 cancer anticytotoxic effects on MnPCEs may boost bone marrow cells' mitotic index[10]. Fatin Khorshid's in vitro study shows that camel milk decreases the growth of tumours and malignant cells such as hepatocellular carcinoma, colon cancer and human brain glioma. Camel milk lactoferin may have anti-cancer qualities because of its direct cell cytotoxicity and anti-angiogenic capabilities, according to Dr. Fatin Khorshid, who conducted the study.

Antibodies found in camel milk may be used to treat cancer; they bind to tumors and destroy them without affecting healthy tissue. Human antibodies are very large, which is problematic[37]. To put it another way, camel milk's antibacterial and antioxidant qualities, as well as its high nutritional content, may be attributed to its beneficial effects on liver function. Additionally, it has been demonstrated that camel milk inhibits fibrin and coagulation, hence limiting the spread of metastatic tumor cells[61].

An anti-ulcer effect has been found in the milk of a camel. Because of its acidic pH, this food includes significant levels of the acid-forming vitamins C, A, B2, and E. (acid). Because of its role in the absorption and

metabolism of these vitamins, magnesium is necessary for their health[62]. Free radical and peroxide damage may be prevented by magnesium's function in the production of glutathione. Magnesium has been shown to significantly enhance antioxidant defenses[63].

Zinc has been shown to protect cells from toxicity and decrease lipid peroxide levels by reducing oxidative stress and apoptosis while activating the antioxidant system. Thus, camel milk may create nitric oxide, which enhances mucus formation and inhibits neutrophil adhesion to endothelial cells.

4.6 Camel Milk Effect as Antiaging

Scientists have suggested that camel milk digestion produces antioxidants and ACE inhibitors in the form of peptides[64]. Vitamin C, which aids in the preservation of collagen, may have a role in the anti-aging properties of camel milk. As an antioxidant, vitamin C found in camel milk helps to repair damaged tissue. This water-soluble vitamin is essential for a healthy immune system since it aids in the synthesis of white blood cells. Coenzyme, which aids in the production of cells and blood vessels, requires vitamin C for its synthesis, according to Natural Standard Research. Because collagen is located in the skin, joints, and cartilage, boosting collagen synthesis may be beneficial for certain people's health. The skin's structural integrity and suppleness are enhanced by vitamin C, which aids wound healing. Vitamin C, an antioxidant, may help neutralize free radicals, which can lead to dry skin and wrinkles if they aren't neutralized. Furthermore. A protein found in camel milk, Lactoferrin, has a higher concentration in camel milk than in cow milk. Free iron from the joints of patients with rheumatoid arthritis is eliminated by this protein[65].

4.7 Therapeutic Effect of Camel Milk on Hepatitis

Hepatitis B and C may be cured by drinking camel milk, according to scientific studies. People with chronic liver disease benefit from camel milk fat, according to research[66]. Another idea is that the high ascorbic acid content in camel milk promotes liver function. According to recent research [2], camel lactoferrin may be used to prevent hepatitis C virus genotype 4. This lactoferrin has higher antiviral and antiparasitic activity than bovine lactoferrin[67,68].

According to anecdotal evidence, the quantity of -hydroxyl acids in camel milk is associated with a more youthful look in females. Alpha-hydroxyl acids aid in the exfoliation of dead skin cells from the epidermis by dissolving the carbohydrates that bind cells together. They Because of this, new, more flexible and translucent cells may form. Alpha-hydroxy acids thin the epidermis, but the thicker dermal layer keeps the epidermis in place. Supplementing camel milk with liposomes, which are naturally present in it, may improve its anti-aging qualities[69].

Vitamin B, vitamin C carotin, and iron levels of this component are essential for good skin. Lanolin and other moisturising components of the milk help to calm and soothe the skin when applied topically. Numerous skin conditions, including as psoriasis, acne, eczema, and dermatitis. By using alpha-hydroxy acids found in camel milk, this product softens and prevents wrinkles while also maintaining the skin's suppleness.

5. Camel Milk vs. Cow Milk

Camel Milk consists of A2 Proteins, while Cow Milk consists of A1 Proteins. Camel Milk carries A2 proteins, which allows in retaining the blood stress beneath control. The presence of A2 proteins even allows in doubtlessly decreasing your ldl cholesterol levels, this means that you could say good-bye to that greater fat! Cow Milk, because it carries A1 proteins, may also reason numerous troubles withinside the frame like inflammation, coronary heart diseases, gastrointestinal discomfort, etc[1,14,25].

5.1 Camel Milk is Useful for Lactose Intolerance

Camel Milk does now no longer comprise Beta-lactoglobulin, that's a chief motive of allergic reaction amongst folks who devour cow milk. Further, it includes much less lactose than cow milk, which makes it greater tolerable for lactose intolerants. There turned into studies performed on 25 patients, with scientific and laboratory diagnoses of lactose intolerance. They had been given each cow and camel milk. Now, for the results! Pasteurized Camel Milk didn't have any bad impact at the patients, while consuming even low quantities of cow milk confirmed vast scientific reactions[14,25].

5.2 Camel Milk Facilitates in Boosting Immunity

Camel Milk carries diverse compounds that assist in combating disease-inflicting organisms. There are

predominant additives to be had in camel milk, that is, lactoferrin and immunoglobulins, which offer the frame with a robust immune system. Lactoferrin has antibacterial, antifungal, anti-inflammatory, antioxidant, and antiviral properties, which assist in inhibiting the increase of micro-organism and viruses, which make the frame extra at risk of cold, cough, fever, etc[43]. Camel milk additionally carries antioxidant properties, which can also additionally assist in permitting your frame to combat loose radical damage. In comparison to this, despite the fact that cow milk has proteins and minerals, it isn't always as excessive as camel milk. It carries magnesium, zinc etc. However the quantity found in its miles decrease than that of camel milk.

6. Conclusion

A combination of emulsified fatty particles and water makes up camel's milk, which is why it is white in colour. Bedouins rely on camel's milk as a mainstay in their diet, while Central Asians have used it as a camel product for millennia. Because camel's milk contains so many vital nutrients, it is a popular choice for health-conscious folks. In camel milk, casein (a kind of milk protein) accounts for more than 70 per cent of the total protein content, and it includes 5.8 per cent lactose as well as a broad spectrum of minerals and vitamins. Arginine, lysine, phenylalanine, anamin, albumin, and globulin, as well as puritans, calcium, and antioxidants are among the product's antibacterial and antifungal ingredients. Diabetics may benefit from the reduced blood sugar levels that come from drinking camel's milk since it reduces the requirement for insulin to keep things under control. Chemical and protein components in supplement aid cure autism in children as well as enhance the immune system and fight off harmful viruses in the human body. Hepatitis and food allergies may also be treated with this supplement.

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