Punjab University Journal of Zoology

35(2): 179-189 (2020)
https://dx.doi.org/10.17582/journal.pujz/2020.35.2.179.189

Review Article

Composition and Beneficial Impact of Camel Milk on Human Health

Sumaira, Ali Mujtaba Shah*, Ghulam Asghar Solangi, Ifra Anwar, Qudratullah Kalwar

Department of Livestock Production, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand-67210, Sindh, Pakistan.

Sumaira and Ali Mujtaba Shah contributed equally in this work.

Article History
Received: May 03, 2020
Revised: May 13, 2020
Accepted: June 27, 2020
Published: August 12, 2020

Authors' Contributions
Sumaira, GAS and IA conceived the study, gathered the data and wrote the manuscript. AMS and QK reviewed the final version of the manuscript.

Keywords
Camel milk, Composition, Immunity, Human health

Abstract | Milk is a complete diet for the human beings because it comprises all the supplements, such as water, fat, carbohydrates, lactose, protein, minerals, nutrients and catalysts. A total of 20 % milk is obtained from different species including sheep, ass, horse, yak, goat, bison and camel while the 80 % milk is produced by cows. Milk of camel plays an essential part in the diet of human. Additionally, camel milk comprises numerous fatty acids and enzymes. Hence camel milk has many beneficial effects, such as antiviral, antibacterial, anti-diabetic, anti-carcinogenic and anti-ageing. Besides, camel milk contains abundant proteins which are conductive to improve the immunity functions. Thus, it is necessary to illuminate the beneficial impact of camel milk and its composition.

Novelty Statement | This review exposed beneficial impact of camel milk on human health, on which previously little information exists. The work may be helpful in future for detailed research on camel milk and its uses for children.

To cite this article: Sumaira, Shah, A.M., Solangi, G.A., Anwar, I., Kalwar, Q., 2020. Composition and beneficial impact of camel milk on human health. *Punjab Univ. J. Zool.*, **35**(2): 179-189. https://dx.doi.org/10.17582/journal.pujz/2020.35.2.179.189

Introduction

Camel milk has been an important source of nutrition for nomadic and pastoral cultures in the arid parts of the world for centuries. More recently, there has been a growing interest in camel milk as an alternative to bovine milk and nutraceutical products because of its high nutritional value and therapeutic effects (Zhang *et al.*, 2020). In Pakistan particularly desert regions of the Sindh, Punjab and Baluchistan around 0.8 million of camels are slaughtered in summer season (Anonymous, 2002). A camel is a cumbersome creature living in desert areas with a population of approximately 34 million as 89 percent is Camelus dromedarius and 11 percent is Camelus bactrianus (FAOSTAT, 2017; Kgaudi *et al.*, 2018) for the processing of milk and meat for human use. Epstein (1971) stated that, 3,000 years ago the camels were the first to be used as a greater source to fetch the water since the end of the first world war with urbanization in armed forces they became an oldest animal to help them in any cause (Yagil *et al.*, 1994). Camel is one of the animal as declared in the Quran as a wonder of God (Derasech, 2005). Dromedary camel lives in the dry land and desert area and it issued for short distance transportation in semiarid and arid regions, besides it also used for milk purpose in certain regions namely raikas and rabaris since hundreds of years (Yagil, 1986).

Camel is significant animal for the peoples of desert tribes in Asia and Africa as a main source of food and also used for transportation since ancient times, its milk

Corresponding Author: Ali Mujtaba Shah
alimujtabashah@sbbuvas.edu.pk; mujtaba43@gmail.com

is being used as a medicine for different infections. Milk of camel, recognized as desert white gold, is more relevant to human milk and varies from other animals milk as it comprises small quantity of sugar and cholesterol whereas, it consist of minerals in greater quantity (magnesium, sodium, iron, potassium, zinc, copper) proteins and vitamin C (Yadav *et al*., 2015; Gader *et al*., 2016). Moreover, milk of camel is used for the curing of various disorders and diseases i.e. jaundice, dropsy, asthma, anti-hypertensive and leishmaniasis (Yardav *et al*., 2015). Yagil (1982) stated that three decades ago, the medical assets of camel milk were investigated. According to investigator, camel milk includes reactive proteins that may have a possibility in improving the immunological defense mechanism. Furthermore, proteins which are present in milk of camel have antiviral and antibacterial properties (El-Agamy *et al*., 1992). Besides it has a hypoglycemic impact while provided as a supportive treatment, and it may be due to the combination of insulin/insulin like protein and has a useful result in the treatment of diabetes. In addition, milk of camel was used for the medication of crohn infection and for food allergies (Shabo and Yagil, 2005). Over the years, camel strengths have been known and its position in mankind history is guaranteed but in Pakistan, studies on production and quality of camel milk are poor. Therefore, assessing the consistency of camel milk in a considerable manor is important to make sure that camel is wonderful animal brings out the best in the heart of subsequent generations. We collected the updated literature examining the compositions and therapeutic properties of camel milk and its positive effects. Hence, the main objectives of this review are to study the useful impacts of camel milk on health of humans, to assess the composition of camel milk also to investigate the purchase and drinking of camel milk.

Camel milk and its composition

Milk of camel is a white liquid with an aroma and salts like flavor. It depends largely on the kind of nutrition or plant accessible in the grazing region (Khalesi *et al*., 2017; Abbas *et al*., 2013). Besides, due to the fats homogenized in the milk, the color of camel milk is white, while the differences in flavor depend on the form of feed or plant present in the grazing area and water for drinking (Kumar *et al*., 2015). Additionally, camel milk pH (6.2 to 6.5) and thickness varies from (1.026 to 1.035) these both are inferior to cow milk and skim milk's optimum buffering potential is at pH of 4.95 (Gul *et al*., 2015). There are various reasons which influence on the quality of camel milk such as, conditions of feeding, physiological stage, physiological and seasonal differences, camel inherent makeup and condition of health (Konuspayeva *et al*., 2009). In general, the normal camel milk comprising ash 0.79%, water 87%, lactose 4.4%, fat 3.5%, protein 3.4%, as mentioned in Table 1. (Al-Haj and Al-Kanhal, 2010).

Table 1: Composition of camel milk and other species of milk (Fox, 2003).

Animal species	Percentage of water	Fat (%)	Protein (%)	Lactose (%)	Ash (%)
Camel	86 to 88	2.9 to 5.4	3.0 to 3.9	3.3 to 5.8	0.6 to 1.0
Cow	85 to 87	3.7 to 4.4	3.2 to.8	4.8 to 4.9	0.7 to 0.8
Buffalo	82 to 84	7.0 to 11.5	3.3 to 3.6	4.5 to 5.0	0.8 to 0.9
Sheep	79 to 82	6.9 to 8.6	5.6 to 6.7	4.3 to 4.8	0.9 to 1.0
Goat	87 to 88	4.0 to 4.5	2.9 to 3.7	3.6 to 4.2	0.8 to 0.9
Human	88 to 89	3.3 to 4.7	1.1 to 1.3	6.8 to 7.0	0.2 to 0.3

Protein

Protein is the key element of camel milk which has a significant effect on its nutritional benefits and technical suitability. Milk proteins are a collection of different mixtures which vary in structure and characteristics. They are classified into fractions of whey protein and clusters of casein. Casein has been the most significant protein in milk, with a fairly small ratio of whey proteins (Guo *et al*., 2007). A large portion in camel milk is casein. Moreover, dromedary camel contains 1.63 to 2.76 percentage of casein protein, which makes up 52 to 87 part of entire milk proteins (Khaskheli *et al*., 2005). Barłowska *et al*. (2007) reported that there are 4 casein variants of the central casein: αs1, αs2, β, and γ, the composition of these proteins is broad and polymorphism showed in many types of animals. Camel milk has a greater β-casein level and lower ÿ- and α casein amounts than cow milk. Casein is easy to digest in intestine and it is an essential source of amino-acids for development and growth of kids. The amino acid structure of camel milk is analogous to cow milk but the quantity of essential and non-essential amino-acids are greater in milk of camel than cow. Casein relative to dairy camel breeds, apart from arginine amounts, which are greater in milk of Safrah breed camel. In cow β-casein quantity of essential amino acids are higher compared to βeta casein in dairy camel breeds, excluding, threonine, lysine, isoleucine and methionine (Salmen *et al*., 2012). Relative to camel milk, the amount of non-essential amino acids in π casein in milk of cow is greater excluding arginine, the amount of which is greater in camel milk ÿ-casein. Cow milk casein includes a higher proportion of essential amino-acids relative to milk of camel, excluding lysine that has a higher proportion in camel-casein (Salmen *et al*., 2012). Besides, serum albumin, peptidoglycan proteins, lact-albumin, lactoferrin, lysozymes, lacto-peroxidase immunoglobulin and whey proteins are existing in milk of camel. Khaskheli *et al*. (2005) stated that milk of camel contains whey protein which make up 20-25 percent of all proteins. The volume of whey proteins in milk of one humped camel ranges between 0.63 to 0.80 percent. Thus, whey proteins are more vigorous in camel milk (Laleye *et al*., 2008).

Links Researchers

Lactose

Previous findings illustrated that normal proportion of lactose in the milk of camel was 4.62% (Sankhla *et al.*, 2000), 3.8-4.3% (Raghvendar *et al.*, 2004), and 5.5% lactose (Schwartz, 1992). The differences in lactose content because camel normally eat grass on extensive range in desert, available arid grasses and salty bushes (Khaskheli *et al.*, 2005). The study of the lactose association with fat particles is considered negative in meta-analysis, although no connection among lactose and total protein is observed (Konuspayeva *et al.*, 2009) that in different season (Haddadin *et al.*, 2008) and in normal health status or in dehydrated conditions (Yagil and Etzion, 1980). There is a slight alteration in the milk of camel composition in different camel breeds worldwide (Mehaia *et al.*, 1995). In milk of bovine the lactose content (4.9%) is more as compared to lactose available in milk of camel (4.2%) (Smits *et al.*, 2011). While another study revealed that content of lactose in milk of buffalo is inferior than the milk of camel and cow (Jaydeep *et al.*, 2015).

Table 2: Chemical composition of milk of various species of camel (Konuspayeva, 2007).

Species	Protein (%)	Fat (%)	Lactose (%)	Dry matter (%)
One humped camel	3.03	5.94	3.12	12.39
Bactrian camel	33.3	6.67	2.77	13.07
Crossbreeds	3.28	6.09	3.04	11.91

Minerals

Minerals are main component of milk; in general minerals available in milk such as: chloride, phosphorus, calcium, sodium, magnesium, potassium and iron. From them calcium and phosphorus are the main components in milk, which are considerable for bone development and normal childbirth health. These minerals have a higher bioavailability impact and nutritional benefits of milk. Previous findings exposed that the quantity of these minerals in milk of camel is higher (Al-Wabel, 2008). Moreover, Mal *et al.* (2007) illustrated that in milk of camel the contents of potassium 50.74 mEqL-1, sodium 29.70 mEqL-1, calcium94.06 mg percent, P values (41.68 mg) and Mg values (11.82 mg percent) found in early lactating camels. The related values in late lactation were 35.49±0.89 mEqL-1, 71.86±1.43 mEqL1, 97.32±0.51 mg percent, 47.14 ± 0.52 mg percent and 13.58 ± 0.31 mg percent respectively. The discrepancies in amounts of macro minerals recorded by numerous study groups may be due to a change in breeds or external factors such as soil and feed. Various camel breeds have unique capacity for storing minerals into their milk (Wangoh *et al.*, 1998). The Fe (1.00012), (Zn 2.00002) and Cu (0.44004 mg / dl) respectively. Also, the trace mineral values such as Zn, Cu and Fe in milk of camel were considerably greater than in milk of other bovines (Singh *et al.*, 2006).

Ash

Konuspayeva *et al.* (2009) determined amount of ash in milk of camel ranges from 0.60-0.90 percent. Moreover, quantity of ash in the milk is associated with type of farming, diet and water intake (Haddadin *et al.*, 2008). Besides, milk of camel is a good source of chloride (Khaskheli *et al.*, 2005) due to feed consumed by camels, such as locust and atriplex tree which normally comprises more content of salt (Yagil, 1982).

Fatty acids

Narmuratova *et al.* (2006) reported that milk of camel contains short chain fatty acid content (C-4 to C-14) and long chain fatty acid content (C-14 to C-18). These polyunsaturated fatty acids are extremely important for nutrition. The camel milk fatty acid contents are mentioned in Table 3.

Table 3: Fatty acids contents in milk of camel (Singh *et al.*, 2006).

Fatty acid	Percentage
Lauricacid	1 to 1.8
Caprylic acid	0.2 to 0.3
Caproic acid	0.2 to 0.6
Buytric acid	0.31 to 0.75
Capric acid	0.2 to 0.4
Myristoleic acid	1.7 to 4.5
Myristic acid	15.9 to 25.2
Palmitoleic acid	6.1 to 19.1
Palmiticacid	25 to 29.5
Oleic acid	6.8 to 24.9
Stearic acid	1.9 to 11.7
Arachidic acid	0.6 to 3.4
Linoleic acid	0.9 to 0.2

Fat

Mansson (2008) stated that the size of fat globules and average diameter was lower in the milk of camel 2.99 µm, while it was higher in milk of buffalo 8.7 µm and goat 3.19 µm. A higher rate of milk fat distribution has a favorable effect on the access for lipolytic enzymes as compared to small fat globules. Hence, milk of goat and camel easy to digest for human beings (D'Urso *et al.*, 2008). A significant proportion of long chain fatty acids differentiate the lipid fraction in milk of camel, which contributes for 96.4 percent contrast to 85.3 percent in milk of bovine (Abbas *et al.*, 2013).

Cholesterol

Cholesterol levels in milk of camel is 34.5 mg/100g which is greater than in cholesterol of other animals, meanwhile, milk fat from dromedary camels produces lower carotene levels and lower sums of short chain fatty acids relative to milk of other animals (Stahl *et al.*, 2006).

Links Researchers

Camel milk, as it has the greatest amount of milk fat dispersion, includes the greatest amount of cholesterol 31.3-37.1 mg/100 g of milk in the examined species of animals. As for its fatty acid profile, camel milk is also exceptional. Gizachew *et al.* (2015) reported that camel contains 6 to 8 times fewer fatty acids in the short chain related to cow, horse, buffalo and sheep milk. Numerous fatty acids such as caproic, arachidic acids, palmitic, butyric, caprylic, lauric, myristoleic, capric, myristic, palmitoleic, linoleic, stearic and oleic acids are existing in camel milk (Panwar, 2015).

Water percentage

Milk of camel includes a large proportion of water that varies from 84 percent to 91 percent (Sisay and Awoke, 2015; Farah and Ruegg, 1989). The ratio of water in milk of camel may be varying depend on the circumstances surrounding the camels (like feed and temperature). Drinking water during the winter, the calf and mother were endorsed to drink only one time in a week for an hour from spring until the completion of summer. The water content of the milk was eighty six percent when water was limited, the water content in the milk increased to ninety one percent when water was limited. Therefore, it seems that the lactating camel at the time is sacrificing water to the milk at the time of drought, perceived to be a common ability to deliver not only nutrients but also crucial fluid to exhausted calf (Yagil and Etzion, 1980).

Vitamins

Numerous vitamins are present in camel milk such as fat and water-soluble vitamins. The vitamins in camel milk are retinol, tocopherol, calciferol and thaimine, and particularly ascorbic acid (Abbas, 2013; Shamsia, 2009). Milk of camel is well recognized as a good source of ascorbic acid 34.16 mg/ L and is 35 fold higher than milk of cow (Stahl *et al.*, 2006). In addition, there is more folic acid, niacin (B3), vitamin B12, pantothenic acid but a lesser amount of retinol and riboflavin present in milk of camel (Stahl *et al.*, 2006). Furthermore, in dromedary camel the amount of vitamin A is lower than the milk of cow 159 I.U./lOOg. Moreover, previous findings of Knoess (1977), illustrated that thiamine and riboflavin content of najdi camel milk were nearly half their values compared with cow milk. While another study stated that the amount of riboflavin in milk of camel was slightly lower than milk of cow (Hartman and Dryden, 1978). However, the content of vitamin B6 and thiamine was similar to that of milk of cow while that of pantothenic acid, folacin, and B12 was lower in cow (Hartman and Dryden, 1978). In camel milk the niacin content was extensively greater than milk of cow. Moreover, vitamin C levels were similar to that of camel milk (Knoess, 1977), but were significantly greater than that of cow milk. The existence in camel milk of fairly good amounts of vitamin C 23.7 mg / kg is of significant importance to human diet in areas where green vegetables and fruits are difficult to access. Anonymous (1980) recommended dietary allowances one kilogram of camel milk provides roughly 50 per cent of vitamin B12, 40 per cent of ascorbic acid, 30 per cent of vitamin A, 24 per cent of vitamins thiamin, niacin, B6, riboflavin and just 1 per cent of folacin. The small amounts of folacin in milk of camel may be nutritionally important.

Dry matter

Kouniba *et al.* (2005) revealed that dry content in milk comprises of fat, lactose, proteins, ash on average of 10.4 percent. Phase of milk production and seasoning have a major effect on daily milk output, dry matter, protein, and fat proportions (Zeleke, 2007). The dry content in milk of camel is identical to that of goat, mare, and milk of donkey. Camel milk main components in dry matter (Average 15.06 percent) are protein (4.9 percent), mineral substances (0.99 percent), milk fat (5.60 percent) and lactose (5.85 percent). While, milk of Bactrian camel has the largest content of dry matter and fat, while in hybrid camel milk has maximum protein content whereas, milk of one humped camel contains maximum content of lactose.

Beneficial effects on human health

In the past mostly peoples use milk of camel as a home remedy for treatment of different diseases. Recently, various researches showed that the remedial assets were due to certain types of constituent in milk of camel (Nora *et al.*, 2014). Meanwhile, nowadays milk of camel is used worldwide, but it is not the primary choice for the peoples because its taste is salty (Zhang *et al.*, 2020; Sisay and Awoke, 2015). Though, it has numerous useful assets as it is used for the treatment for autism, allergy, diabetes and also stops liver cirrhosis. Camel milk is becoming familiar because of its health benefits in managing and helping to prevent various health issues (Korish and Arafah, 2013). In the Raica population in India, there is a low occurrence of diabetes drinking camel milk habitually (Agrawal *et al.*, 2003). Milk of camel is necessary for the control of diabetes (Shori, 2015). Additionally, attentiveness related to camel milk and its medicinal and nutritional profits increased (Jamshed *et al.*, 2016). Milk of camel contains antimicrobial properties including, antiviral, antibacterial, and antifungal. Then cure from the assault of pathogens and various diseases that will promote a solid way to balance a life (Jamshed *et al.*, 2016). Camel milk is better than cow and buffalo; much importance has been given in recent times to the use of camel milk for human wellbeing (Sahani *et al.*, 1998, 2005). However, the mindfulness among everyone on its clinical, favorable circumstances are less. Individuals who are presented to the way of life infections or have a family ancestry of diabetes, heart sicknesses, and so on are as a rule looking for elective treatments. They favor options in contrast to traditional medications. Camel milk has been recognized as aiding the recuperation procedures of immune system infections

Links Researchers

having a snappy and constructive outcome on the mending procedure (Ahmed *et al*., 2015). In this way, milk of camel is helpful in the sugar patients and other way of life maladies. We needed to discover whether individuals who are presented to these sorts of maladies are all the more ready to get it after realize the medical advantages of camel milk. Thus, we set the individuals presented to a way of life sicknesses are additionally ready to purchase camel milk.

Chemical imbalance range issue (ASD)

Numerous findings have shown that oxidative stress plays a major part in the rehabilitation of many neurological disorders including autism spectrum disorder; some researches also indicated that antioxidant enzymes play path physiological role in autism. Camel milk has also identified to possibly have positive effects in autism. A survey was conducted to assess the influence of camel milk drinking on oxidative stress biomarkers in autistic children, using the ELISA technique to measure the plasma levels of glutathione, myeloperoxidase and superoxide dismutase prior and 2 weeks afterward usage of camel milk. All evaluated parameters showed significant difference after consumption of the camel milk. These results showed that camel milk may play a vital role in reducing oxidative stress by altering the amounts of antioxidant enzymes and non enzymatic antioxidant molecules, as demonstrated by the strengthened childhood autism rating scale (Agrawal *et al*., 2005).

Camel milk against gastrointestinal scatters

Milk of camel includes a large anti-inflammatory protein content, which has a beneficial impact on the disorders of intestinal and stomach. The large number of poly-unsaturated and mono fatty acids and its comprises more vitamins which provides expanded metabolism for carbohydrates (Konuspayeva *et al*., 2008; Karray *et al*., 2005). In addition, fermented camel milk has been found to have an enzyme (Angiotensin Iconverting enzyme, ACE) (Quan *et al*., 2008), which enables the digestion of milk proteins (Alhaj *et al*., 2006). Latest researches for the wellbeing of the stomach-related framework indicated that camel milk has hostile to looseness of the bowels properties and all youngsters, who have taken camel milk and with the 20 episodes of loose bowels every day are restored with ordinary solid discharges. Camel milk can likewise be utilized in little kids who have looseness of the bowels by nourishment pollution with rotavirus, since milk of camel is wealthy in against rotavirus antibodies (Yagil, 2013).

Nourishment hypersensitivities

Camel milk has already shown possible effect in food allergy care. A research has explored the effect of camel milk and cow's milk on hypersensitivity. Some researchers found that camel milk has an optimistic result in kids with serious food allergies. This investigation is experimental work to develop a deeper insight of the ability of the greater camel milk in children for food allergies. People, identified and studied using two separate methods of electrophoresis. These findings suggest that milk proteins which are existing in milk of camel is useful in food allergies (El-sayed *et al*., 2009).

Ceaseless hepatitis and hepatitis C contamination

Sharmanov *et al*. (1982) was the first one to indicate an antiviral function of camels milk, and they noticed that milk of camel is beneficial in enhancing and reinforcing the biochemical and clinical condition of patients with chronic active hepatitis than mare's milk. Previous studies presented that camel lactoferrin effectively prevents hepatitis C virus genotype 4 infection of human peripheral blood leucocytes and the human leukocyte incubation with camel LF accompanied by HCV infection stopped the virus from entering the cells. The assumption was that the direct association between HCV and camel LF resulted in a complete inhibition of virus entry into the cells; in this regard, camel lactoferrin seemed to be a more active antiviral agent than bovine and human lactoferrin. Moreover, the application of milk of camel clears schistosoma mansoni from diseased mice, signifying a further helpful anti parasitic activity in milk of camel (Galil *et al*., 2016).

Camel's milk against diabetes

Earlier outcomes presented that milk of camel is beneficial in diabetes (Malik *et al*., 2012; Al-Haj and Al-Kanhal, 2010; Agrawal *et al*., 2007). In India, the individuals which use milk of camel has zero percent diabetic cases, while other which not use milk of camel for drinking having 5.5 percent diabetic patients (Agrawal *et al*., 2011). Furthermore, after the utilization of milk in diabetic patients declines their normal insulin level from 30to 35 per cent with low blood sugar levels (Shori, 2015) besides, milk of camel also comprises insulin and insulin like proteins, immunoglobulin and trace components which have anti-inflammatory qualities (Gader and Alhaider, 2016; Agrawal *et al*., 2011). Insulin in the milk of the camel varies from human insulin and other animals because it is accompanied by micelles which protect it from digestion and degeneration at the edge of the digestive system, making it easier to consume and pass into the blood (Zagorski *et al*.,1998; Abu Lehia, 1989). Current researches of experimental diabetic patients have shown they can resist diabetes related kidney damage (Kaskous, 2016; Shori, 2015; Hamad *et al*., 2011). Antioxidants present in milk of camel may suppress indications of metabolic syndrome such as rise of lipids and blood glucose (Gader and Alhaider, 2016). Milk of camel is ideal for lactose intolerant people due to low content of lactose in camel milk as comparison to milk of cow (Baubekova *et al*., 2015; Cardoso *et al*., 2010; Zibaee, 2015).

Links Researchers

Camel milk against crohn's disease

In several countries the Crohn's disease is now an outbreak. Recently growing evidence implies a primary disease of mycobacterium avium sub species of para-tuberculosis. This mycobacterium could extent through milk of cow, as pasteurization is not affected. Apparently mycobacterium passes through mucosa as saprophytes and becomes active only when the individual is under excessive stress leading to secondary autoimmune reaction. Because the bacteria relate to the tuberculosis family and milk of camel is been used to cure tuberculosis, it is clear that the strong bactericidal assets of camel milk combined with PGRP impact the healing process rapidly and positively. Moreover, the attack of immunoglobulin the anti DNA reestablishes the immune system (Urazakov and Bainazarov, 1991).

Antibacterial qualities of camel milk

Milk of camel consist of many enzymes and proteins that have antibacterial and immunological qualities (Farah, 1993). Proteins and their immunological action are: lysozyme which contributes in the primary immune system, which is concentrated on targeting structures specific to invasive pathogens. Immunoglobulins provide the body protection against pathogens. Additionally, Iron saturated lactoferrin (after lactation) stops microbial growth in the intestine and contributes in the immune system, which is focused on combating pathogen invading specific structures (Kiselev, 1998; Ueda *et al.*,1997; Conesa *et al.*, 2008). Evidently, milk of camel provides much more lactoferrin than goat, cow and sheep milk. Lacto peroxidase: has an anti-cancer and bactericidal activity. Human thyroid peroxidase containing iodination and thyroid hormone coupling; peptidoglycan protein recognition is existing in the maximum proportion in the milk of camel and these have remarkable effect in the cancer of breast to regulating metastasis, enhancing the immune system of the host. Furthermore, N-acetyl-glucosaminidase also present in milk of camel in higher amount as comparison with other mammalians which has antibacterial and antiviral activities (Hoelzer *et al.*,1998).

Antiviral assets of camel milk

Previous findings illustrated that milk of camel is effective against numerous deadly animal viral pathogens such as FMD (Foot and mouth disease), rinderpest and in rift valley fever. (Koerhler-Rollefsen *et al.*, 2001). Additionally, Martin *et al.* (1997) stated that the viral enzyme system is active and selective inhibitor of camel milk antibodies.

Camel milk against Cancer

Different logical examinations indicated that after drinking of camels milk results in decline of the formation of disease cells (Magjeed, 2005). Thus, a gathering of researchers have built up a recipe for the control of malignant growth. They reported that single dosages produced effective results in mouse and now need to attempt to occur in human. The outcomes indicated that a great success rate in control of blood malignancy. The medication may likewise be utilized effectively to treat lung, liver, and bosom-malignant growth.

Korashy *et al.* (2012) reported that milk of camel stimulates the proliferation of cells in MCF7 (human breast) and HepG2 (human hepatoma). The mechanisms regulated by cell proliferation and death receptor activation in both the cell lines and oxidative stress (Korashy *et al.*, 2012). Also, Habib *et al.* (2013) argued that milk of camel prevents the existence and propagation of HepG2 and MCF7 cells by stimulating the intrinsic and extrinsic apoptotic pathways. Consequently, efficacy of lactoferrin which is present in milk of camel has capability to impede colon cancer cell line proliferation.

MDR and its therapy from camel's milk

Camel milk has magnificent impact on curing tuberculosis particularly those pain from MDR, as said by Gorakh *et al.* (2000) and Alwan and Farhuni (2000). The research of medical benefit of camel milk for MDR was performed by Mal *et al.* (2000) determined that milk intake had a beneficial effect in patients with tuberculosis. In addition to that another study revealed that camel milk provide contains essential proteins that play key role in strengthening the function of immune defense and these proteins have antibacterial properties which kill mycobacterium tuberculosis (Mal *et al.*, 2006).

Arthritis and its treatment from camel milk

Milk of camel contains a higher level of chelating iron content known as lactoferrin. This protein extracts free iron from arthritic patient joints and thereby enhances arthritic function (Panwar, 2015).

Skin sickness treatment and restorative estimations of camel milk

Researchers suggest the amount of vitamin B, carotin C and iron are important for the skin. Besides that milk of camel also comprises lanolin and other hydrating assets which have relaxing and positive influence on the skin. While holding the skin perfectly used for treating skin conditions like, eczema, acne, dermatitis and psoriasis. Milk of camel is also a normal source of alpha-hydroxyacids which soften the skin and keep it smooth and prevent from wrinkles.

Camel milk impact as anti-aging

Salami *et al.* (2011) examined the impact of camel milk as antiaging and proposed that when milk of camel is ingested and after digestion, peptides begin to function as natural antioxidants. Milk of camel is ideal for anti-aging, as it contains higher percentage vitamin C which protects collagen. Moreover, vitamin C has tissue repair and

activities and antioxidant properties. In Adding Vitamin C used to strengthen the immune system and it is important in the body for the development of a protein and collagen that are helpful in development of vessels and it provides strength and firmness to skin. Furthermore, vitamin C also enhances the skin structural strength and durability and helps recover. Besides, this vitamin decreases down the wrinkles formation on the skin. Because of the inclusion of α-hydroxyl acids which are considered to smoothies fine lines and plump the skin, it means that camel milk has anti-aging effect ant it also supports to dissolve the external sweaty coating of dead skin cells by reducing sugar level that are used to bind together skin cells. This allows exposing new, more flexible and transparent cells. The α-hydroxyl acids help remove crinkles and age spots and alleviate dryness because the α-hydroxyl acids make the skin's external layer thinner and improve the dermis' lower layer by making it thicker. Moreover, liposome that exist in camel milk are essential to a possible cosmetic ingredient to enhance the anti-aging effect (Kula and Tegegne, 2016).

Milk of camel used against tuberculosis

In India, a clinical investigation has determined that patients of tuberculosis vastly improved by the utilization of camel milk. So it occurred that in the camel milk testing sample, treated with 1 liter/day and patient as a dietary supplement and after usage they noted that no any chest pain and cough sputum appear. Ultimately, the community, which receives camel milk as a supplement, improve weight gain and hunger (Mal *et al*., 2006). The precise pattern of patients drinking additional camel milk in better condition has not yet been studied (Wernery and Yagil, 2012).

Immunity and milk of camel

Camel's milk is now being observed across several tests to boost the immune function (El-Agamy *et al*., 2009). Moreover, sequence of protein in milk of camel varies from that of the protein in milk of cow (El-Agamy *et al*., 2009). Whereas, immunoglobulin in milk of camel is comparable to that of the human but its content in the camel milk as correlated to human (Mullaicharam, 2014). Milk of camel includes antioxidants (lactoferrin) that strengthen the efficiency of the human body's immune system, thereby effectively combating various disease pathogens (Conesa *et al*., 2008). Therefore, milk of camel is beneficial for disorders of immune system such as crohn's and sclerosis infection, it means that immune problems are easily treated with milk of camel.

Camel milk and its other advantages

Milk of camel can even be used to treat various disorders of cardiovascular system (Al-Hashem, 2009; Agrawal *et al*., 2009, 2011). Besides, milk of camel is now being found to suppress blood fibrinogen levels in rats having diabetes. Additionally, milk of camel is also a healthy source of vitamin c, niacin, calcium, proteins and phosphorus. Besides, milk of camel also strengthens the normal protection mechanisms of the body (Zibaee, 2015).

Conclusions and Recommendations

In short, it could be concluded that milk of camel has valuable nutritional and therapeutic properties. Milk of camel is a good source of protein, vitamin C, calcium, phosphorus, niacin and it fulfills all the requirement of the body. Moreover, milk of camel is also beneficial for the curing of autism, diabetes, diarrhea, allergy, autoimmune and metabolic diseases etc. This review may be helpful for people to understand the importance and profits of camel milk for health of human. In future we should study how camel milk regulate the internal physiology of human body against various disease and mechanism.

Conflict of interest

The authors have declared no conflict of interest.

Reference

Abbas, S., Ashraf, H., Nazir, A. and Sarfraz, L., 2013. Chemical analysis and composition of camel milk. *Int. Res.* **2**: 85–98.

Abbas, S., 2013. Physico-chemical analysis and composition of camel milk. *Int. Res. J*., **2**: 84-98.

Abbas, S., Hifsa, A., Aalia, N. and Lubna, S., 2013. Physico-chemical analysis and composition of camel milk. *Int. Res*., **2**: 85-98.

Abdel-Galil, M. and Abdel-Gader, M.B.B.S., 2016. PhD, FRCP (London and Edinburgh) and Abdulqader A. Alhaider, B. Pharm, MSc, PhD, The unique medicinal properties of camel products-A review of the scientific evidence. *J. Taibah Univ. Med. Sci*., pp. 1-6.

Abu-Lehia, I.H., 1989. Physical and chemical characteristics of camel milkfat and its fractions. *Fd. Chem*., **34**: 261-271. https://doi.org/10.1016/0308-8146(89)90103-9

Agrawal, R.P., Budania, S., Sharma, P., Gupta, R., Kochar, D.K., Panwar, R.B. and Sahani, M.S., 2007. Zero prevalence of diabetes in camel milk consuming raica community of NorthWest Rajasthan, India. *Diabetes Res. Clin. Pract*., **76**: 290-296. https://doi.org/10.1016/j.diabres.2006.09.036

Agrawal, R.P., Jain, S., Shah, S., Chopra, A. and Agarwal, V., 2011. Effect of camel milk on glycemic control and insulin requirement in patients with Type 1 diabetes: 2-years randomized controlled trial. *Eur. J. Clin. Nutr.,* **65**: 1048. https://doi.org/10.1038/ejcn.2011.98

Ahmed, I.A., Mohamed, E.E., Babiker, A. and Eshraga, A.E., 2015. Physicochemical, microbiological and sensory characteristics of yoghurt produced from

Links Researchers

camel milk during storage. Bactrian and Dromedary camels. *Livest. Res. Rural Dev.*, **22**: 2305–2313.

Al-Haj,O.A.andAl-Kanhal,H.A.,2010.Compositional, technological and nutritional aspects of dromedary camel milk. *Int. Dairy J.*, **20**: 811–821. https://doi.org/10.1016/j.idairyj.2010.04.003

Alhaj, O.A., Kanekanian, A. and Peters, A., 2006. The effect of Bifidbacterium lactic and trypsin on cholesterol. *In: International food and health innovation conference*, Malmö, Skane Food Innovation Network, Sweden

Al-Hashem, F.H., 2009. Camel's milk alleviates oxidative stress and lipid peroxidation induced by chronic aluminum chloride exposure in rat's testes. *Am. J. Appl. Sci.*, **6**: 18687-242. https://doi.org/10.3844/ajassp.2009.1868.1875

Al-Wabel, N., 2008. Mineral contents of milk of cattle, camels, goats and sheep in the central region of Saudi Arabia. *Asian J. Biochem.*, **3**: 373–375. https://doi.org/10.3923/ajb.2008.373.375

Alwan, A.A. and Farhuni, A.H., 2000. *The effect of camel milk on Mycobacterium tuberculosis in man*. In: Proc. 2nd Int. Camelid Conf. Agro-Econ. Camelid Farming. Almaty, September, pp.100.

Anonymous, 2002. *Economic Survey, Finance Division Government of Pakistan, Economic Advisors wing*. Islamabad

Anonymous, 1980b. *Recommended Dietary Allowances, 9th ed*. National Research Council/National Academy of Science, Wash- ington, DC.

Barłowska, J., Litwi, C., Kedzierska-Matysek, M. and Litwi, C., 2007. Non Polymorphism of caprine milk αs1-casein in relation to performance of four polish goat breeds. *Pol. J. Vet. Sci.*, **10**: 159–164.

Baubekova, A., Kalimbetova, A., Akhmetsadykova, S., Konuspayeva, G. and Faye, B., 2015. Comparison of d and l-lactate content in cow and camel milk. *Veterinaria*, **42**: 397-398.

Cardoso, R.R.A., Santos, R., Cardoso, C.R.A. and Carvalho, M.O., 2010. Consumption of camel's milk by patients intolerant to lactose. A preliminary study. *Rev. Alerg. Mex.*, **57**: 26-32.

Conesa, C., Sánchez, L., Rota, C., Pérez, M.D., Calvo, M., Farnaud, S. and Evans, R.W., 2008. Isolation of lactoferrin from milk of different species: Calorimetric and antimicrobial studies. *Comp. Biochem. Physiol. B Biochem. Mol. Biol.*, **150**: 131-139. https://doi.org/10.1016/j.cbpb.2008.02.005

D'Urso, S., Cutrignelli, M., Calabr, S., Bovera, F., Tudisco, R., Piccolo, V. and oInfascelli, F., 2008. Influence of pasture on fatty acid profile of goat milk. *J. Anim. Physiol. Anim. Nutr.*, **92**: 405–410. https://doi.org/10.1111/j.1439-0396.2008.00824.x

Deuraseh, N., 2005. The urine of camels. Treatment of diseases in AL-Tibb Al-Nabawi. *Int. Med. J.*, **4**: 25-28.

El-Agamy, S., Ruppanner, R., Ismail, A., Champagne, C. and Assaf, R., 1992. Antibacterial and Antiviral activity of camel milk protective proteins. *J. Dairy Res.*, **59**: 169–175. https://doi.org/10.1017/S0022029900030417

El-Agamy, E.I., Nawar, M., Shamsia, S.M., Awad, S. and Haenlein, G.F.W., 2009. Are camel milk proteins convenient to the nutrition of cow milk allergic children. *Small Rumin. Res.*, **82**: 1-6.

Elsayed, I., El-Agamy, Nawar, M., Sherif, M., Awad, S. and Haenlein, G.F.W., 2009. Are camel milk proteins convenient to the nutrition of cow milk allergic children. *Small Rumin. Res.*, **82**: 1-6. https://doi.org/10.1016/j.smallrumres.2008.12.016

El-Sayed, M.K., Al-Shoeibi, Z.Y., El-Ghany, A.A.A. and Atef, Z.A., 2011. Effects of camels milk as a vehicle for insulin on glycaemic control and lipid profile in Type 1 diabetics. *Am. J. Biochem. Biotechnol.*, **7**: 179-189. https://doi.org/10.3844/ajbbsp.2011.179.189

Epstein, H ., 1971. The origin of the domestic animals of Africa. Vol. 2. Africana Publ. Corp. New York.

FAOSTAT, 2017. Statistical data. Food and Agriculture Organization of the United Nations, Rome, Italy http://www.fao.org/faostat/en/#data/QA access: 12.05.2019.

Farah, Z., 1993. Composition and characteristics Camel milk. *J. Dairy Re.s*, **60**: 603-626. https://doi.org/10.1017/S0022029900027953

Farah, Z. and Ruegg, M.W., 1989. The size distribution of casein micelles in camel milk. *Fd. Struct.*, **8**: 6.

Fox, P.F., 2003. Milk. In: H. Roginski, J.W. Fuquary, P.F. Fox, editors. Encyclopedia of dairy sciences. New York, NY: Academic Press; **3**: 458–466.

Gader, A.G.M.A. and Alhaider, A.A., 2016. The unique medicinal properties of camel products: A review of the scientific evidence. *J. Taibah Univ. Med. Sci.*, **11**: 98-103. https://doi.org/10.1016/j.jtumed.2015.12.007

Galil, A., Abdel G.M. and Abdulqader, A.A., 2016. The unique medicinal properties of camel products: A review of the scientific evidence. *J. Taibah Univ. Med. Sci.*, **11**: 98-103.

Gizachew, A., Teha, J. and Birhanu, T., 2015. *Ethiopia Nekemte*. Review on Medicinal and Nutritional Values of Camel Milk.

Gorakh, M.D., Sena, D.C., Jain, V.K. and Sahani, M.S., 2000. *Therapeutic utility of camel milk as nutritional supplement against multiple drug resistant patients.* In: Proc. 2nd Int. Camelid Conf. Agro-economics of Camelid Farming. Almaty, September, pp. 99.

Gul, W., Farook, N., Anees, D., Khan, U. and Rehan, F., 2015. Camel milk: a boon to mankind. *Int. J. Res. Stud. Biosci.*, **3**: 23–29.

Guo, H., Pang, K., Zhang, X., Zhao, L., Dong M. and Ren, F., 2007. Composition, physicochemical

properties, nitrogen fraction distribution,and amino acid profile of camel milk. *J. Dairy Sci.,* **90**: 1635–1643. https://doi.org/10.3168/jds.2006-600

Habib, H.M., Ibrahim, W.H., Schneider-Stock, R. and Hassan, H.M., 2013. Camel milk lactoferrin reduces the proliferation of colorectal cancer cells and exerts antioxidant and DNA damage inhibitory activities. *Fd. Chem.*, **141**: 148-152. https://doi.org/10.1016/j.foodchem.2013.03.039

Haddadin, M.S.Y., Gammoh, S.I. and Robinson, R.K. 2008. Seasonal variations in the chemical composition of camel milk in Jordan. *J. Dairy Res.,* **75**: 8-12. https://doi.org/10.1017/S0022029907002750

Hamad, E.M., Abdel-Rahim, E.A. and Romeih, E.A., 2011. Beneficial effect of camel milk on liver and kidneys function in diabetic sprague-dawley rats. *Int. J. Dairy Sci.*, **6**: 190-197. https://doi.org/10.3923/ijds.2011.190.197

Hartman, A.M. and Dryden, L.P., 1978. *The vitamins in milk and milk products*. In "Fundamentals of Dairy Chemistry," 2nd ed., Avi Publishing Co., Westport, CT. pp. 325.

Hoelzer, W., Muyldermans, S. and Wernery, U., 1998. A note on camel IgG antibodies. *J. Camel Pract.* Res., **5**: 187-188.

Jamshed, S.Q., Khan, M.U., Ahmad, A. and Elkalmi, R.M., 2016. Knowledge, perceptions, and attitudes toward complementary and alternative medicines among pharmacy students of a Malaysian Public University. *J. Pharm. Bio. Sci.*, **8**: 34–38. https://doi.org/10.4103/0975-7406.171686

Jaydeep, Y., Bhavbhuti, M., Mehta, Wadhwani, K.N., Darji, V.B. and Aparnathi, K.D. 2015. Evaluation and comparison of camel milk with cow milk and buffalo milk for gross composition. *J. Camel Pract. Res.,* **21**: 259–265. https://doi.org/10.5958/2277-8934.2014.00046.0

Karray, N., Lopez, C., Ollivon, M. and Attia, H., 2005. la matiere grasse du lait de dromadaire: Composition, microstructure et polymorphisme. *Une Rrevue OCL.*, **12**: 439-446. https://doi.org/10.1051/ocl.2005.0439

Kaskous, S., 2016. Importance of camel milk for human health. *Emir. J. Fd. Agric.*, **28**: 158-163. https://doi.org/10.9755/ejfa.2015-05-296

Kgaudi, K., Seifu, E. and Teketay, D., 2018. *Milk production potential and major browse species consumed by dromedary camels in Tshabong*. Botswana Notes and Records, Golden Jubilee Volume in Honour of Sir Katunale Masire. pp. 50.

Khalesi, M., Salami, M., Moslehishad, M., Winterburn, J. and Moosavi-Movahedi, A.A., 2017. Biomolecular content of camel milk: a traditional superfood towards future Health care industry. *Trends Fd. Sci. Technol.*, **62**: 49–58. https://doi.org/10.1016/j.tifs.2017.02.004

Khaskheli, M., Arain, M.A., Chaudhry, S., Soomro, A.H. and Qureshi, T.A., 2005. Physico-chemical quality of camel milk. *J. Agric. Soc. Sci.,* **2**: 164–166.

Kiselev, S., 1998. Molecular cloning and characterization of the mouse tag-7 gene encoding a novel cytokine. *J. Biol. Chem.*, **273**: 1863318639. https://doi.org/10.1074/jbc.273.29.18633

Knoess, K.H., 1977. The camel as a meat and milk animal. *World Anim. Rev.,* **22**: 39.

Konuspayeva, G., 2007. *Variabilite physico-chimique et biochimique du lait des grands camelide's* (Camelus bactrianus, Camelus dromedarius et hybrides) au Kazakhstan. Universite Montpellier II, France, 255.

Konuspayeva, G., E. Lemarie, B. Faye, G. Loiseau and D. Montet. 2008. Fatty acid and cholesterol composition of camels (Camelus bactrianus, Camelus dromedarius and hybrids) milk in Kazakhstan. *Dairy Sci. Technol.*, **88**: 327-340. https://doi.org/10.1051/dst:2008005

Konuspayeva, G., Faye, B. and Loiseau, G., 2009. The composition of camel milk: a meta-analysis of the literature dana, *J. Fd. Comp. Anal.,* **22**: 95-101. https://doi.org/10.1016/j.jfca.2008.09.008

Korashy, H.M., Maayah, Z.H., Abd-Allah, A.R., El-Kadi, A.O.S. and Alheider, A.A., 2012. Camel milk triggers apoptotic signaling pathways in human hepatoma HepG2 and breast cancer MCF7 cell lines through transcriptional mechanism. *J. Biomed. Biotechnol.*, **2012**: 1-9. https://doi.org/10.1155/2012/593195

Korish, A.A. and Arafah, M.M., 2013. Camel milk ameliorates steatohepatitis, insulin resistance, and lipid peroxidation in experimental non-alcoholic fatty liver disease. *BMC Complement. Altern. Med.*, **13**: 264–276. https://doi.org/10.1186/1472-6882-13-264

Kouniba, A., Berrada, M., Zahar, M. and Bengoumi, M., 2005. Composition and heat stability of Moroccan camel milk. *J. Camel Pract. Res.,* **12**: 105-110.

Kumar, YK., Rakesh, K., Lakshmi, P. and Jitendra, S., 2015. Compositionandmedicinal properties of camel milk: A review. *Asian J. Dairy Fd. Res.*, **34**: 83–93. https://doi.org/10.5958/0976-0563.2015.00018.4

Laleye, L.C., Jobe, B. and Wasesa, A.A.H., 2008. Comparative study on heat stability and functionality of camel and bovine whey proteins, *J. Dairy Sci.,* **91**: 4527-4534. https://doi.org/10.3168/jds.2008-1446

Magjeed, N.A., 2005. Corrective effect of milk camel on some cancer biomarkers in blood of rats intoxicated with Aflatoxin B1. *J. Saudi Chem. Soc.*, **9**: 253-263.

Mal, G., Sena, D.S., Jain, V.K. and Sahani, M.S., 2006. Therapeutic value of camel milk as nutritional supplement for multiple drug resistant (MDR) tuberculosis patients. *J. Vet. Med.,* **61**: 88-91.

Mal, G., Suchitra Sena, D., Jain, V.K., Singhvi, N.M.

and Sahani, M.S., 2000. Role of camel milk as an adjuvant nutritional supplement in human tuberculosis patients. *Livest. Int.*, **4**: 7-14.

Mal, G., Suchitra-Sena, D. and Sahani, M., 2007. Changes in chemical and macro-minerals content of dromedary milk during lactation. *J. Camel Pract. Res.*, **14**: 195-197.

Malik, A., Al-Senaidy, A., Skrzypczak-Jankun, E. and Jankun, J., 2012. A study of the anti-diabetic agents of camel milk. *Int. J. Mol. Med.,* **30**: 585-592. https://doi.org/10.3892/ijmm.2012.1051

Mansson, H., 2008. Fatty acids in bovine milk fat. *Fd. Nutr. Res.*, **52** https://doi.org/10.3402/fnr.v52i0.1821

Martin, F., Volpari, C., Steinkuhler, C. and Dimas, N., 1997. Affinity selection of a camelized V (H) domain antibody inhibitor of hepatitis Cvirus NS3 *protease. Prot. Eng.*, **10**: 607-614. https://doi.org/10.1093/protein/10.5.607

Mehaia, M.A., Hablas, M.A., Abdel-Rahman, K.M. and El-Mougy, S.A., 1995. Milk composition of Majaheim, Wadah and Hamra camels in *Saudi Arabia. Fd. Chem.,* **52**: 115–122. https://doi.org/10.1016/0308-8146(94)P4189-M

Mullaicharam, A.R., 2014. A review on medicinal properties of camel milk. *World J. Pharm. Sci.,* **2**: 237-242.

Narmuratova, M., Konuspayeva, G., Loiseau, G., Serikbaeva, A., Natalie, B., Didier, M. and Bernard, F., 2006. Fatty acids composition of dromedary and Bactrian camel milk in Kazakhstan. *J. Camel Pract. Res.* **13**: 45-50.

Nora, F.Z., Peter, N. and Varga, L., 2014. Production, general characteristics, chemical composition and health benefits of camel milk. *Magy. Allatorvosok Lapja*, **136**: 553–557.

Panwar, R., 2015. *Camel milk: Natural medicine-Boon to dairy industry*.

Quan, S., Tsuda, H. and Miyamoto, T., 2008. Angiotensin I-converting enzyme inhibitory peptides in skim milk fermented with lactobacillus Helvetius 130B4 from camel milk in Mongolia, China. *J. Sci. Fd. Agric.*, **88**: 2688-2692. https://doi.org/10.1002/jsfa.3394

Agrawal, R.P., Beniwal, R., Sharma, S., Kochar, D.K., Tuteja, F.C., Ghorui, S.K. and Sahani, M.S., 2005. Effect of Raw Camel Milk in Type 1 Diabetic Patients, *J. Camel Pract. Res.,* **12**: 2735.

Raghvendar, S., Shukla, K.S., Sahani, S.M. and Bhakat, C., 2004. *Chemical and physico-chemical properties of camel milk at different stages of lactation*. International Conference, on Camel Milk, Sadri, Rajasthan, India.

Sahani, M.S., Agrawal, R.P., Tuteja, F.C., Ghouri, S.K., Aminudeen, R. and Sena, D., 2005. Hypoglycemic activity of camel milk in straptozotocin induced hyperglycemia in rats. *Int. J. Diabetes Dev. Coun.*, **75**: 1436–1437. https://doi.org/10.4103/0973-3930.22776

Sahani, M.S., Rathinasabapathy, M., Gorakhmal. and Khanna, N.D., 1998. Milking technique and other factors affecting milk production potential in different breeds of camels under farm conditions. *Indian J. Anim. Sci.,* **68**: 254–256.

Salami, M., Moosavi-Movahedi, A.A., Moosavi-Movahedi, F., Ehsani, M.R., Yousefi, R., Farhadi, M. and Haertlé, T., 2011. Biological activity of camel milk casein following enzymatic digestion. *J. Dairy Res.,* **78**: 471-478. https://doi.org/10.1017/S0022029911000628

Salmen, S.H., Abu-Tarboush, H.M., Al-Saleh, A.A. and Metwalli, A.A. 2012. Amino acids content and electrophoretic profile of camel milk casein from different camel breeds in Saudi Arabia, *Saudi J. Biol. Sci.,* **19**: 177-183. https://doi.org/10.1016/j.sjbs.2011.12.002

Sankhla, A.K., Gupta, M.P., Aarti, and Dashora, P.K., 2000. Proximate composition and physico-chemical characteristics of camel milk produced in South Rajasthan. *Indian J. Dairy Sci.,* **53**: 61-63.

Schwartz, H.J., I992. Productive performance and productivity of dromedaries (Camelus dromedarius). *Anim. Res. Dev.,* **35**: 85-98.

Shabo, Y. and Yagil, R., 2005. Etiology of autism and camel milk as therapy. *Int. J. Disabil. Hum. Dev.,* **4**: 67–70. https://doi.org/10.1515/IJDHD.2005.4.2.67

Shamsia, S.M., 2009. Nutritional and therapeutic properties of camel and human milks. *Int. J. Gen. Mol. Biol.,* **1**: 52-58.

Sharmanov, T.S., Zhangabylov, A.K. and Zhaksylykova, R.D., 1982. Mech-anism of the therapeutic action of whole mare's and camel's milk in chronic hepatitis. *Vopr. Pitan.,* **1**: 17e23.

Shori, A.B., 2015. Camel milk as a potential therapy for controlling diabetes and its complications: A review of in vivo studies. *J. Fd. Drug. Anal.*, **23**: 609–618. https://doi.org/10.1016/j.jfda.2015.02.007

Singh, R., Ghorui, S. and Sahani, M., 2006. *Camel milk: Properties and processing potential*. In Sahani, M.S. The Indian camel. NRCC, Bikaner. pp. 59-73.

Sisay, F. and Awoke, K., 2015. Review on production, quality and use of camel milk in Ethiopia. *J. Fish. Livest. Prod.*, **3**: 1–4. https://doi.org/10.4172/2332-2608.1000145

Smits, M.G., Huppertz, T., Alting, A.C. and Kiers, J., 2011. Composition, constituents and properties of dutch camel milk. *J. Camel Pract. Res.,* **18**: 1–6.

Stahl, T., Sallmann, H.P., Duehlmeier, R. and Wernery, U., 2006. Selected vitamins and fatty acid patterns in dromedary milk and colostrums. *J. Camel Pract. Res.,* 13: 53-57.

Kula, T. and Tegegne, D., 2016. Chemical Composition and Medicinal Values of Camel. *J. Res. Stud. Biosci.*, (*IJRSB*), **4**: 13-25.

Ueda, T., Sakamaki, K., Kuroki, T., Yano, I. and Nagata, S., 1997. Molecular cloning and characterization of the chromosomal gene for human lactoperoxidase. *Eur. J. Biochem.*, **243**: 32-41. https://doi.org/10.1111/j.1432-1033.1997.0032a.x

Urazakov, N. and Bainazarov, S., 1991. The 1st clinic in history for the treatment of pulmonary Tuberculosis with camel's sour milk. *Probl. Tuberk.*, **2**: 89-90.

Wangoh, J., Farah, Z. and Puhan, Z., 1998. Composition of milk from three camel (Camelus dromedarius) breeds in Kenya during lactation. *Milchwissenschaft*, **53**:136–139.

Wernery, R. and Yagil, R., 2012. *Medicinal properties in camel milk for treatment of Epidemic Diseases*. Proceedings of the 3rd ISOCARD International Conference, 29th January-1st February 2012 Muscat, Sultanate of Oman, pp. 225-227.

Yadav, Alok and Kumar, 2015. Composition and medicinal properties of camel milk: A Review. *Asian J. Dairy Fd. Res.*, **34**: 83-91. https://doi.org/10.5958/0976-0563.2015.00018.4

Yagil, R. and Etzion, Z., 1980. Effect of drought condition on the quality of camel milk. *J. Dairy Res.*, **47**: 159–166. https://doi.org/10.1017/S0022029900021026

Yagil, R., Zagorski, O., Van Creveld, C. and Saran, A., 1994. Science and camel's milk production. In Actes du Colloque: *Dromadaires et chameaux animaux laitier*, pp. 75-89.

Yagil, R., 1982. *Camels and camel milk: FAO Animal Production and Health*. Rome: Publications Division, Food and Agriculture Organization of the United Nations. pp. 26.

Yagil, R., 1986. The camel: Self- sufficiency in animal protein in drought- stricken areas. *World Anim. Rev. (FAO)*, **57**: 2-10.

Yagil, R., 2013. Camel milk and its unique anti-diarrheal properties. *Isr. Med. Assoc. J.*, **15**: 35-36.

Yagil, R. and Etzion, Z., 1980. The effect of drought conditions on the quality of camel's milk. *J. Dairy Res.*, **47**: 159–166. https://doi.org/10.1017/S0022029900021026

Zagorski, O., Maman, A., Yaffe, A., Meisler, A., Van Creveld, C. and Yagil, R., 1998. Insulin in milk-a comparative study. *Int. J. Anim. Sci.*, **13**: 241-244.

Zeleke, M., 2007. Non-genetic factors affecting milk yield and milk composition of traditionally managed camels (*Camelus dromedarius*) in Eastern Ethiopia. *Livst. Res. Rural Dev.*, **19**: 6. http://www.utafoundation.org/lrrd1906/zele19085.htmeferences

Zhang, B.., Xu, S., Villalobos-Santeli, J.A. and Huang, J.Y., 2020. Fouling characterization of camel milk with comparison to bovine milk. *J. Fd. Eng.*, pp. 110085. https://doi.org/10.1016/j.jfoodeng.2020.110085

Zibaee, S., 2015. Nutritional and therapeutic characteristics of camel milk in children: A systematic review. *Elect. Phys.* **7**: 1523. https://doi.org/10.19082/1523