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## Medicinal value of camel milk and meat

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### ABSTRACT

Camel milk and meat are good source of nutrients for the peoples living especially in the arid and urban areas. Camel milk and meat are unique from other ruminant's milk and meat in terms of composition as well as claimed health effects. Camel milk has low cholesterol, high minerals (sodium, potassium, iron, copper, zinc and magnesium) and high vitamin C when compared with other ruminant milk. Camel milk contains various fatty acids, enzymes and protective proteins. Camel milk has potential therapeutic effects, such as antibacterial, antiviral, antidiabetic, anti-ageing and anticarcinogenic. The medicinal properties of camel milk can be attributed to the presence of protective proteins, which may possibly play a pivotal role for the enhancement of immune defence mechanism. Not only camel milk, but also camel meat in general, is considered a functional food for cures and remedy for many ailments such as seasonal fever, sciatica, shoulder pain, asthma, removing freckles and for improved performance, in many cultures around the world. Therefore, it is important to illustrate the overview of compositions and medicinal values of camel milk and meat.

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Antimicrobial; camel meat; camel milk; composition; immunity; medicine

## 1. Introduction

Camels are multipurpose animals; they are used for milk, meat and hide supply, as well as for other purposes such as transport, entertainment, celebration and competition as in racing and beauty show. The camel is of significant socio-economic importance in many arid and semi-arid parts of the world and its milk constitutes an important component of human diets in these regions (Farah 1986). Camel milk is still the most important nutritional source for pastoralists in many African and Asian countries (Valérie 2007). Camels produce more milk of high nutritional quality and for a longer period of time than other species in an environment that may be rightly termed as hostile in terms of extreme temperature, drought and lack of pasture (Yagil and Etzion 1980; Valérie 2007).

The milk has many properties that make it a very useful choice, as camel's milk is used in some parts of the world to cure certain diseases (Attia et al. 2001). The medicinal property of camel milk was reported three decades back by Yagil (1982). According to the author, camel milk contains protective proteins, which may have possible role for enhancing immune defence mechanism. Since then, significant numbers of studies have been conducted to determine the therapeutic properties of camel milk. Antibacterial and antiviral activities of the protective proteins of camel milk were studied by El-Agamy et al. (1992). Camel milk has insulin-like activity, regulatory and immunomodulatory functions on  $\beta$ -cells. It exhibits hypoglycaemic effect when given as an adjunctive therapy, which might be due to the presence of insulin/insulin-like protein in it, and possesses beneficial effect in the treatment

of diabetic patients. Furthermore, camel milk has been used for the treatment of food allergies, Crohn's disease and autism (Shabo and Yagil 2005).

Camel meat is a significant source of animal protein in many African and Asian countries, especially in areas where the climate adversely affects the production efficiency of other animals. The culinary and cooking practices, as well as the palate for meat, in several African and Arabian countries have evolved to prefer camel meat to other meat animal species because of beliefs in medicinal benefits, its availability and/or affordable price (Bekhit and Farouk 2013). Camel meat is healthier because the carcass contains less fat and has lower levels of cholesterol in the fat than other meat animals. Camel meat is also relatively high in polyunsaturated fatty acid in comparison to beef (Dawood and Alkanhal 1995; Al-Ani 2004). This is an important factor in reducing the risk of cardiovascular disease, which is related to saturated fat consumption. Camel meat is also used for remedial purposes for diseases such as hyperacidity, hypertension, pneumonia and respiratory disease, and as an aphrodisiac (Kurtu 2004). Very recently, Kula (2016) reviewed the medicinal values of camel milk. We gathered and compiled the literatures up to date to overview the compositions and medicinal values of camel milk and meat.

Therefore, the objectives of this review are:

- To review the compositions and medicinal values of camel milk and meat;
- To illustrate scientific evidences on the therapeutic effect of camel milk and meat.

## 2. Overview of camel milk and meat

### 2.1. Chemical composition of camel milk

Camel's milk has generally an opaque white colour and has a faint sweetish odour and sharp taste; sometimes, it can be salty (Abbas et al. 2013). Its opaque white colour is because of the fats that are finely homogenized throughout the milk, whereas the changes in taste are caused by the type of fodder and availability of drinking water (Kumar et al. 2015). Its density ranges from 1.026 to 1.035 and the pH from 6.2 to 6.5; both are lower than those of the cow's milk, and the maximum buffering capacity of skim milk is at pH 4.95 (Gul et al. 2015).

Physiological stage, feeding conditions, season, physiological variations, genetic make-up and health status of the camel were reported to influence the composition of camel milk (Konuspayeva et al. 2009). In general, the average amount of components of camel milk is protein 3.4%; fat 3.5%; lactose 4.4%; ash 0.79%, while water covers 87% (Al-Haj and Al-Kanhal 2010) (Table 1).

Various minerals such as Na, K, Ca, P, Mg, Fe, Zn, Cu and vitamins (A, E, C and B1) are present in camel milk (Khasmi et al. 2001; Onjoro et al. 2003). The values of trace minerals were significantly higher in camel milk as compared to cow's milk (Agrawal et al. 2004). The concentration of vitamin C in camel milk is two to three times higher as compared to cow's milk (Stahl et al. 2006). The low pH due to higher concentration of vitamin C stabilizes the milk and therefore it can be kept for relatively longer periods without cream layer formation. The availability of relatively higher amount of vitamin C in camel milk is of significant relevance from the nutritional point of view, as it exerts powerful antioxidant activity (Mal et al. 2007). The levels of vitamin A, E and B1 were reported to be low in camel milk compared to the cow's milk. Cow's milk contains a carotene that lacks in camel milk (Stahl et al. 2006).

Various fatty acids such as butyric, caproic, caprylic, capric, lauric, myristic, myristoleic, palmitic, palmitoleic, stearic, oleic, linoleic and arachidonic acids are present in camel milk (Narmuratova et al. 2006).

Camel milk also contains enzymes such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma glutamyl transferase ( $\gamma$ -GT), acid phosphatase (ACP), alkaline phosphatase (ALP) and lactate dehydrogenase (LDH). These enzymes play an important role in keeping the quality of camel milk.  $\gamma$ -GT can be used as an indicator for the proper heat treatment of camel milk. This also contains a number of protective proteins such as lysozyme, lactoferrin, lactoperoxidase and peptidoglycan recognition protein (PGRP). These

proteins possess broad-spectrum antimicrobial activity and thus have the ability to enhance the shelf life of camel milk (Wernery 2007).

### 2.2. Composition of camel meat

Camel meat varies in composition according to breed type, age, sex, body condition and site of the carcass. Water content differs only slightly between species, while differences in the fat content are more marked (Sales 1995). Camel meat contains 70–77% moisture (Dawood and Alkanhal 1995; Al-Sheddy et al. 1999; Al-Owaimer 2000; Kadim et al. 2006b). It is also a good source of protein containing about 20–23% (Al-Owaimer 2000; Kadim et al. 2006b).

Camel meat, like other red meats, contains high levels of potassium followed by phosphorus, sodium, magnesium and calcium, plus smaller percentages of other trace elements. Calcium content of camel meat is higher than that of beef which may partly explain the tight structure of some cuts of camel meat (El-Faer et al. 1991; Dawood and Alkanhal 1995).

The amino acid and inorganic mineral contents of camel meat are high compared to beef due to the lower levels of fat content in the meat of the dromedary (Alkanhal 1994; Kurtu 2004; Kadim et al. 2006a).

## 3. Medicinal value of camel milk and meat

### 3.1. Medicinal value of camel milk

The camel milk is being consumed for centuries by nomadic peoples due to its nutritional and medicinal properties. The medicinal properties of camel milk can be attributed to the presence of protective proteins, which may possibly play a pivotal role for the enhancement of immune *Mycobacterium tuberculosis* (Sharma and Singh 2014). In addition, camel milk also plays an important role to a control number of physical health disorders or even mental disorders.

#### 3.1.1. Antimicrobial and immunological activities

Camel milk contains various protective proteins [lactoferrin, lactoperoxidase, N-acetyl- $\beta$ -glucosaminidase (NAGase), PGRP, Igs and lysozyme] which exert antibacterial, antiviral, antifungal and antiparasitic activity, immunological properties, growth promotion activity and anti-tumour activity (Amany et al. 2005; Conesa et al. 2008; Mona et al. 2010; Gizachew et al. 2014) (Table 2).

Nevertheless, some of them have specific properties in camel's milk. Lactoferrin: Iron-saturated lactoferrin (from second week lactation) prevents microbial growth in gut, participates in primary immune system, which is based on targeting of structures common to invading pathogens. Camel milk apparently contains much more lactoferrin than ruminant (cow, sheep and goat) milk. Camel milk is rich in lactoferrin with potent antimicrobial and anti-inflammatory properties, including bacterial inhibition (*Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Clostridium* and *Helicobacter pylori*), antiviral effects [hepatitis C virus [HCV], CMV, herpes simplex virus-1 and human immunodeficiency virus (HIV, the virus responsible for AIDS)], antifungal effects (*Candida albicans*),

**Table 1.** Proximate chemical composition of camel milk and other species' milk.

Species of the animal	Water (%)	Protein (%)	Fat (%)	Ash (%)	Lactose (%)
Camel	86–88	3.0–3.9	2.9–5.4	0.6–1.0	3.3–5.8
Cow	85–87	3.2–3.8	3.7–4.4	0.7–0.8	4.8–4.9
Buffalo	82–84	3.3–3.6	7.0–11.5	0.8–0.9	4.5–5.0
Sheep	79–82	5.6–6.7	6.9–8.6	0.9–1.0	4.3–4.8
Goat	87–88	2.9–3.7	4.0–4.5	0.8–0.9	3.6–4.2
Human	88–89	1.1–1.3	3.3–4.7	0.2–0.3	6.8–7.0

Source: Fox (2003).

**Table 2.** Average concentrations of lactoferrin, lysozyme and immunoglobulins G in milk of different species (mg/l).

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

Source: Pandya and Khan (2006); El-Hatmi et al. (2007); Park et al. (2007); Wheeler et al. (2007); Konuspayeva et al. (2007); Stelwagen et al. (2008); Dračková et al. (2009); Liu et al. (2009).

immunosupportive and immunomodulating functions (regulates the maturation and activation of neutrophils and macrophages), the maturation and function of lymphocytes (antioxidant and anti-inflammatory) and anti-cancer actions (Habib et al. 2013; Kanwar et al. 2015). Studies have shown that camel lactoferrin markedly inhibits HCV genotype 4 infection of human peripheral blood leucocytes and that the incubation of human leucocytes with camel lactoferrins followed by their infection with HCV prevented the entry of the virus into the cells. The conclusion was that the direct interaction between the HCV and camel lactoferrins led to complete inhibition of virus entry into the cells; in this respect, camel lactoferrin proved to be a more potent antiviral agent than bovine and human lactoferrins (EL-Redwan and Tabll 2007).

Lysozyme is a protective enzyme found in higher concentration in camel milk than in cow's milk. It has antibacterial activity against gram-positive bacteria like NAGase found in similar quantities in human milk (Gul et al. 2015). PGRP is highest in concentration in camel milk (where it was first discovered) than in cow's milk. It has apparent effect on breast cancer by controlling metastasis and stimulates the host's immune response. NAGase has an antibacterial activity and so strengthens the antibacterial-antiviral activity of the milk. It is noteworthy that the NAGase activity is similar to that in human milk, confirming the nutritional advantages of camel milk over cow's milk (Gizachew et al. 2014).

**Immunoglobulins:** these give immune protection to the body against infections. Camel has an amazing and complex immune system, different from all other mammals as reported by Hamers-Casterman et al. (1993). IgM, IgG, IgA and even IgD have been detected in camel sera on the basis of cross-reactivity with human immunoglobulins (Abu-Lehiya 1997). Subclasses IgG2 and IgG3 (natural for camels) consist of only two heavy chains. Light chains (VL) are not present. There is a single V domain (VHH). Camel VHH has a long complementary determining region (CDR3) loop, compensating for the absence of VL. Conventional antibodies rarely show a complete neutralizing activity against enzyme antigens (Hamers 1998).

Camel IgG has a full neutralizing activity against tetanus toxin, as it enters (1999). A major flaw in the development of human immunotherapy is the size of the antibodies. The comparative simplicity, high affinity and specificity of camel Igs, and the potential to reach and interact with active sites allow for penetration of dense tissues to reach the antigen. Camels' immune system is stronger than that of humans. As immunoglobulins are found in camel milk throughout lactation, drinking

milk will provide a tool for combating autoimmune diseases by rehabilitating the immune system (Muyldermans et al. 2001).

### 3.1.2. Antidiabetic property

There is a traditional belief in the Middle East that regular consumption of camel milk helps in the prevention and control of diabetes. Recently, it has been reported that camel milk can have such properties: (i) insulin in camel milk possesses special properties that make absorption into circulation easier than insulin from other sources or causes resistance to proteolysis; (ii) camel insulin is encapsulated in lipid vesicles that makes possible its passage through the stomach and entry into the circulation. However, we cannot exclude the possibility that insulin in camel milk is present in nanoparticles capable of transporting this hormone into the bloodstream. However, much more probable is that camel milk contains 'insulin-like' small molecule substances that mimic insulin interaction with its receptor (Ajamaluddin et al. 2012).

In India, a comparison between conventionally treated juvenile diabetes with those also drinking camel milk showed that the group drinking the milk had significantly reduced blood sugar and reduced haemoglobin levels (Agrawal et al. 2002). The amounts of injected insulin were also significantly reduced. Insulin in milk is proved by the following many research outcomes: (a) Camel milk contains large concentrations of insulin 150 U/ml. (b) Fasted and dehydrated rats and rabbits had a decline in blood sugar after receiving camel milk. (c) Streptozotocin-induced diabetes in rats was controlled and cured with camel milk. (d) Although human, cow and goat milks contain insulin, it is degraded in the acid environment of the stomach. This does not occur with camel milk, which does not react to acid and no coagulum is formed (Zagorski et al. 1998).

A long-term study was undertaken previously to assess the efficacy, safety and acceptability of camel milk as an adjunct to insulin therapy in type 1 diabetics. In randomized clinical, parallel design study, type 1 diabetic patients were enrolled and divided into two groups. Group I received usual care that is diet, exercise and insulin, and Group II received camel milk in addition to the usual care. Insulin requirement was titrated weekly by blood glucose estimation. The results showed that, in camel milk group, there was decrease in mean blood glucose, haemoglobin and insulin doses. It may be stated that camel milk is safe and efficacious in improving long-term glycaemic control, with a significant reduction in the doses of insulin in type 1 diabetic patients (Amjad et al. 2013).

### 3.1.3. Treatment for autism and Crohn's disease

**Therapeutic effect of camel milk for Autism:** a malfunction of the immune system causes an alimentary enzyme inhibition, causing the breakdown of casein into casomorphin, not to amino acids. The casomorphin is a powerful opioid, much more potent than morphine itself and is able to cause brain damage and cognitive and behavioural symptom of autism. Autistic children drinking camel milk have had amazing improvements in their behaviour and diets (Shabo and Yagil 2005). Extensive studies have demonstrated that oxidative stress plays a vital role in the pathology of several neurological



diseases, including Alzheimer or autism spectrum disorder (Christen 2000; Al-Ayadhi and Mostafa 2013).

*Camel milk as a therapy for Crohn's disease:* Crohn's disease is becoming an epidemic in many countries. Lately, increasing evidence points that Crohn's disease is caused by a primary bacterial infection, *Mycobacterium avium* – subspecies *paratuberculosis* (MAP). This mycobacterium could spread via cow's milk, as it is unaffected by pasteurization. Apparently, MAP enters the mucosa as saprophytes and only becomes active when the persons are in severe stress, leading to a secondary autoimmune response (Urazakov and Bainazarov 1991).

Shabo et al. (2008) reported that camel milk drinking has shown good effect for treating Crohn's diseases. As the bacteria belong to the family of tuberculosis and as camel milk has been used to treat tuberculosis, it becomes apparent that the powerful bactericide properties of camel milk combined with PGRP have a quick and positive effect on the healing process. In addition, immunoglobulins restore the immune system.

### 3.1.4. Treatment for allergies

The fact that camel milk lacks beta lactoglobulin and has different beta casein structure (mainly of A2 subtype against A1 for a big proportion of cows), two powerful allergens in cow's milk, makes the milk attractive for children suffering from milk allergies (Makinen-Kiljunen and Palosuo 1992; Merin et al. 2001).

According to El-Agamy et al. (2009), the absence of immunological similarity between camel and cow milk proteins may be taken as an important criterion from nutritional and clinical points of view. Another pertinent fact is that the components of camel milk include immunoglobulins similar to those in mothers' milk, which reduce children's allergic reactions and strengthen their future response to foods (Makinen-Kiljunen and Palosuo 1992). Phylogenetic differences could be responsible for the failed recognition of camels' proteins by circulating IgEs and monoclonal antibodies. It appears that camel milk has a positive effect when drunk by children with severe food allergies. The reactions are rapid and long lasting (Restani et al. 1999).

### 3.1.5. Anti-cancer and anti-tumour action

Camel milk has been shown to trigger apoptosis (controlled cell death) in human breast cancer and liver cancer cells via epigenetic mechanisms (Korashy et al. 2012; Wernery and Yagil 2012). Korashy et al. (2012) demonstrated that camel milk induces apoptosis in human hepatoma (HepG2) and human breast (MCF7) cancer cells through apoptotic- and oxidative-stress-mediated mechanisms. In addition, camel milk helps to restore after anti-tumour treatments by their antige-notoxic and anticytotoxic effects through inhibition of micro-nucleated polychromatic erythrocytes, and improves the mitotic index of bone marrow cells (Salwa and Lina 2010). Habib et al. (2013) examine the functional properties of camel milk lactoferrin, the main iron-binding protein of the milk, which showed 56% reduction of colorectal cancer growth. It interacts with polysaccharides ligands on cell surfaces and may activate cell signalling pathways such as the Fas pathway, resulting in the inhibition of tumour growth via apoptosis. Lactoferrin of camel milk, already described for its bacteriostatic activity, can also penetrate cells and function

as a transcription factor, activating the transcription of specific DNA sequences. Thus, lactoferrin has potential in tumour treatment by blocking tumour cell proliferation. A study has reported that high concentrations (3–5 mg/ml) of camel milk lactoferrin inhibit the proliferation of HCT-116 colon cancer cells by as much as 56%. In contrast, no significant inhibition of cell proliferation was noted at lower concentrations ( $\leq 1$  mg/ml) (Tsuda and Sekine 2000).

Very active antibodies in camel milk can also bind onto the tumours in tissue, killing the tumour cells without damaging healthy tissues. But human antibodies are too big to do this (Levy et al. 2013). It is also revealed that anti-tumour properties of camel milk are due to strong antimicrobial and antioxidative activities that help in the reduction of liver inflammation, and camel milk is rich with nutrients that are required for healthy liver function. Conversely, the lactoferrin in camel milk is also shown to have a potential thrombolytic action, as it causes inhibition of coagulation and fibrin formation which in turn hinders the spread and growth of metastatic tumour cells (Gader and Alhaider 2016; García-Montoya et al. 2012).

### 3.1.6. Cosmetic and anti-ageing effect

Camel milk has cosmetic effects due to the presence of  $\alpha$ -hydroxyl acids which are known to plump and smoothies the skin.  $\alpha$ -Hydroxyl acids help to shed the outer horny layer of dead cells on the skin (epidermis) by helping to break down sugars, which are used to hold skin cells together. This helps in revealing new cells, which are more elastic and clear.  $\alpha$ -Hydroxyl acids help to eliminate wrinkles and age spots and relieve dryness, as they make the outer layer of the skin thinner and support the lower layer of the dermis by making it thick. In addition, liposome occurring in camel milk is applicable for a potential cosmetic ingredient to improve anti-ageing effect (Choi et al. 2013).

Vitamin C in camel milk has antioxidant and tissue repair protection activities (Escott-Stump 2008) Vitamin C is necessary in the body for the production of collagen, a protein that aids in the growth of cells and blood vessels and gives skin its firmness and strength. Collagen is found in the skin and joints. By increasing the production of collagen, vitamin C strengthens the structural support and resiliency of skin and helps repair. Vitamin C is an antioxidant that slows the rate of free-radical damage which causes skin dryness and wrinkles (Baumann 2007). Furthermore, camel milk has a higher amount of iron-chelating protein known as lactoferrin. This protein removes free iron from joints of arthritic patients and thereby improves their welfare (Panwar et al. 2015).

### 3.1.7. Better choice for lactose-intolerant people

Camel milk is easily digestible and readily metabolized by human body (De-Almeida 2011; Shabo et al. 2005; Ehlal et al. 2011). That could explain a more rapid elimination of lactose and could contribute to the reduction of gastrointestinal disorders that occur in individuals intolerant to lactose as shown by Cardoso et al. (2010) in a preliminary study. Nevertheless, these results need to be verified at a larger scale.

### 3.2. Medicinal value of camel meat

Meat is a valuable food source rich in many essential amino acids, minerals (e.g. iron, zinc and selenium), vitamins (e.g. vitamin E and vitamin B groups), bioactive compounds (Q10, carnosine, anserine, glutathione) and some essential fatty acids such as omega-3 fatty acids. Apart from the nutritional value of meat, it provides several eating attributes and fulfilling experiences that are normally not achieved by other protein sources. Beef, lamb, pork, poultry and fish are considered the major sources of meat protein worldwide. However, in African, Middle Eastern and some Asian countries, especially in arid and semi-arid regions, camel meat is regarded as a main source of animal protein that equals and in some cases surpasses other meats in commercial importance (Williams 2007; Schönfeldt and Gibson 2008).

Several epidemiological studies linked health problems such as obesity and high saturated fat and cholesterol intake to increased consumption of animal products (Biesalski 2005; Chao et al. 2005). This has led to a concern that total dietary fat intake should be restricted by consuming smaller portions less frequently or replacing red meat consumption with white meat. The growing evidence of low cholesterol and fat content in camel meat could potentially support its healthiness as a better alternative to the high fat and cholesterol meats such as mutton and beef (Schönfeldt and Gibson 2008).

The low bioaccumulation of pesticides in camel meat (Sallam and Morshedy 2008) is particularly of interest because many African countries still have major problems with organochlorine abuse in terms of the inventory of obsolete pesticides or the lack of control over their use, which consequently leads to health problems (Daba et al. 2011). Camels are, however, mostly reared in arid regions where the use of pesticides is limited; it might be the lack of exposure rather than natural low bioaccumulation that is the cause of the low organochlorines observed by Sallam and Morshedy (2008). Further research is required to ascertain this phenomenon. Regardless of the outcome (either through lack of exposure or low bioaccumulation mechanisms), however, the potential of the lower pollutant levels in camel meat in the diet cannot be disregarded. There are a few reports indicating a lower prevalence of different microorganisms in camel meat compared with lamb, goat and beef (Rahimi et al. 2010) or the availability of natural antagonists against *Listeria monocytogenes* (El Malti and Amarouch 2008).

Low levels of saturated fat in the diet are important for avoiding atherosclerosis because of their effect on plasma cholesterol levels. Low intakes of saturated fatty acids and cholesterol are important for the control of obesity, and hypercholesterolaemia, and to decrease the risk of cancer (Chizzolini et al. 1999). Health organizations recommended reductions in total fat intake, particularly saturated fatty acids and, at the same time, increase in the consumption of polyunsaturated fatty acids which are considered beneficial to human health, due to anticarcinogenic, antiatherogenic and immunomodulating properties (Mulvihill 2001). This renders the camel meat with its low fat and cholesterol content a healthy food.

Moreover, camel meat is believed by Somali and Indian people to have remedial effects for as many as 13 different

diseases, including hyperacidity, hypertension, pneumonia and respiratory diseases and also to be an aphrodisiac (Kurtu 2004).

Meat in general is considered a functional food for cures of many ailments and for improved performance in many cultures around the world (Migdal and Žirkovic 2007). Camel meat and offal such as liver are believed to have medicinal effects and are often eaten raw that is definitively forbidden because of possible risk of zoonotic infection like Plague (Bin Saeed et al. 2005).

Kadim et al. (2008) indicated that camel meat has traditionally been used to cure the following ailments in some Middle Eastern countries: (i) seasonal fever, sciatica and shoulder pain, as well as for removing freckles (by placing hot camel meat slices on the freckled area); (ii) camel meat soup was used to cure corneal opacity and to strengthen eyesight; (iii) camel fat was used to ease haemorrhoidal pains and the hump fat was used to remove tapeworm and (iv) dried camel lungs used to be prescribed as a cure for asthma, especially if taken with honey.

In conclusion, camel milk has valuable nutritional and therapeutic properties; however, a lot is left to be explored. Further studies will be required to establish camel milk and meat as therapeutic agent. Further controlled experimental studies on different breeds of animals managed under similar management and environmental condition will also be needed to confirm the reported low level of organochlorines and certain microorganisms in camel meat compared with other red meats. The digestibility of lactose of camel milk by lactose-intolerant people should also be further investigated, as there are conflicting ideas regarding this issue. The consumption and therapeutic use of camel milk and meat should be advocated. Thus, researchers, healthcare professionals and all concerned bodies should advocate about the benefit of camel milk and meat through mainstream and social media.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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