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, low sugar, high minerals (sodium, potassium, iron, copper, zinc and magnesium), and high vitamin C when compared with other ruminant milk. Camel milk has potential therapeutic effects, such as anti- bacteria, anti-viral, anti-diabetic, anti-aging and anti-carcinogenic. It is often easily digested by lactose-intolerant individuals. The medicinal properties of camel milk can be attributed due to presence of protective proteins, which may possibly play pivotal role for enhancement of immune defense mechanism. Not only camel milk, but also camel meat in general is considered a functional food for cures and remedial of 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, and hence provide scientific evidence on the therapeutic effect of camel milk and meat for treatment of different diseases. As a result, the consumption and therapeutic use of camel milk and meat should be enhanced and practiced in different health care services.
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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 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 before three decades by Yagil (1982). According to the author, camel milk contains protective proteins which may have possible role for enhancing immune defense 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 β cells. It exhibits hypoglycemic effect when given as an adjunctive therapy, which might be due to 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 over 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 as well as an aphrodisiac (Kurtu, 2004).

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 is generally an opaque white color and has a faint sweetish odor and sharp taste; sometimes it can be salty (Abbas *et al*., 2013). Its opaque white color because of the fats 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 1.026-1.035 and the pH from 6.2-6.5, both are lower than those of the cow's milk and maximum buffering capacity of skim milk is at pH 4.95 (Gul *et al*., 2015).

Physiological stage, feeding conditions, season, physiological variations, genetic makeup, 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 protein3.4%; fat 3.5%; lactose 4.4%; ash 0.79%, while water covers 87% (Al-Haj and Kanhal, 2010).

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).

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

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 compare to cow milk (Agrawal *et al*., 2004; Arrowal, 2005). The concentration of vitamin C in camel milk is 2-3 times higher as compared to cow 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 anti-oxidant 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 milk. Cow milk contains â carotene but lack 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 arachidic acids are present in camel milk (Narmuratova *et al*., 2006).

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

2. 2. Composition Of Camel Meat

Camel meat varies in composition according to breed type, age, sex, condition and site on the carcass. Water content differs only slightly between species, while differences in 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*., 2006). It is also a good source of protein containing about 20–23% (Al-Owaimer, 2000; Kadim *et al*., 2006).

Camel meat like other red meats contains high levels of potassium followed by phosphorus, sodium, magnesium and calcium, respectively, plus smaller percentages of other 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 and Mahgoub, 2006).

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 pivotal role for enhancement of immune defense mechanism. Antibacterial and antiviral activities of camel milk proteins have been investigated *e.g.* it inhibits *Mycobacterium tuberculosis* (Sharma *et al.,* 2014). In addition camel milk also plays an important role to control number of health disorder such as diabetes, allergy, autism etc.

3.1.1. Antimicrobial activities

Camel milk contains various protective proteins (lysozyme, lactoferrin, lactoperoxidase, NAGase, PGRP, IgG and IgA) which exert antibacterial, antiviral, antifungal and antiparasitic activity, immunological properties, growth promotion activity and anti-tumor activity (Amany *et al*., 2005; Conesa *et al*., 2008; Mona *et al*., 2010).

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 (HCV, CMV, herpes simplex virus-1, and human immunodeficiency virus (HIV, the virus responsible for AIDS)), antifungal effects (Candida albicans), 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).

Broad antimicrobial activity *N-acetyl-§-glucosaminidase (NAGase)*: The milk enzyme 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 women's milk, confirming the nutritional advantages of camel milk over cow milk (Hoelzer *et al*., 1998).

The early observations of Sharmanov *et al*., (1982) were the first to suggest an anti-viral action of camel milk when they found that camel's milk was more effective than mare's milk in improving and normalizing the clinical and biochemical status of patients with chronic active hepatitis. Later observations using camel urine therapy in patients with Bilharzial liver disease supported this finding, as significant improvement was noted in the clinical condition of these patients with marked resolution of the ascites and morphological changes of the cirrhotic liver (O'hag *et al*., 2000). Subsequent studies have shown that camel lactoferrin markedly inhibits hepatitis C virus genotype 4 infection of human peripheral blood leukocytes 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 anti-viral agent than bovine and human lactoferrins (Redwan and Tabll, 2007). Additionally, camel milk administration clears Schistosoma Mansoni from infected mice, thereby indicating a further beneficial anti-parasitic action of camelmilk (Maghraby *et al*., 2005).

3.1.2. Immunological activity

Camel immune system: IgM, IgG, IgA and even IgD have been detected in camel sera on the basis of cross-reactivity with human immunoglobulins (Abu-Lehiya, 1997). Hamers-Casterman *et al.* (1993) described the amazing camel immune system, different from all other mammalians. 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 have a long complementary determining region (CDR3) loop, compensating for absence of the 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 the ezymes structure. Camel hypervariable regions have increased repertoire of antigen binding sites. Camel VHH domains are better suited to enzyme inhibitors than human antibody fragments, thus offering a potential for viral enzymatic neutralization (Riechmann and Muylderman, 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 rather than is depression (Muylderman *et al*., 2001).

Camel milk contains various protective proteins mainly enzymes which exert antibacterial and immunological properties. The presence of these proteins helps to explain some of the natural healing properties of the milk (Farah, 1993). According to Ueda *et al*., 1997; Kiselev, 1998 and Conesa *et al*.,

2008, the known protective proteins, and their immunological action, in camel milk are: *Lysozymes*; participates in primary immune system, which is based on targeting of structures common to invading pathogens. *Immunoglobulins*; These give the immune protection to the body against infections; *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 in ruminant (cow, sheep and goat) milk; *Lactoperoxidase:* is found in milk, tears and saliva. It contributes to the non-immune host defense system, exerting bactericidal activity(mainly on gram negative bacteria), has growth promotion activity, has anti-tumor activity, has a close relation (71%) to human thyroid peroxidase, which is involved in iodination and coupling in the formation of the thyroid hormones; *Peptidoglycan recognition protein(PGRP):* the highest concentrations of this enzyme is in camel milk, was first discovered in camel milk, has apparent effect on breast cancer by controlling metastasis, stimulates the host's immune response.

3.1.3. Anti-diabetic 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 makes absorption into circulation easier than insulin from other sources or cause 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. Although, much more probable is that camel milk contains 'insulin-like' small molecule substances that mimic insulin interaction with its receptor (Ajamaluddin *et al.,* 2012).

The 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, hemoglobin and insulin doses. It may be stated that camel milk is safe and efficacious in improving long-term glycemic control, with a significant reduction in the doses of insulin in type 1 diabetic patients (Amjad *et al.*, 2013).

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 hemoglobin 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. As fasting nullifies insulin secretion, the drop in blood sugar indicates insulin activity. (c) Streptozotocin induced diabetes in rats was controlled and cured with camel milk. (d) Although human, cow and goat milk 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).

3.1.4. Treatment for autoimmune disease

Camel milk has been identified as assisting in the recovery processes of autoimmune diseases such as autism and Crohn's disease.

Therapeutic effect of camel milk for Autism: As a malfunction of the immune system causes an alimentary enzyme inhibition, causing the breakdown of casein, not to amino acids, but to casomorphine. The casomorphine is a powerful opioid, much more potent than morphine itself. Autistic children drinking camel milk have had amazing improvements in their behavior 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 autism spectrum disorder (ASD) (Christen, 2000; Al-Ayadhi and Mostafa, 2013); those studies proposed that GSH and antioxidant enzymes have a pathophysiological role in autism. Furthermore, camel milk has emerged to have potential therapeutic effects in autism. The previous studies evaluated the effect of camel milk consumption on oxidative stress biomarkers in autistic children, by measuring the plasma levels of glutathione, superoxide dismutase, and myeloperoxidase before and 2 weeks after camel milk consumption, using the ELISA technique. All measured parameters exhibited significant increase after camel milk consumption. These findings suggest that camel milk could play an important role in decreasing oxidative stress by alteration of antioxidant enzymes and nonenzymatic antioxidant molecules levels, as well as the improvement of autistic behaviour as demonstrated by the improved Childhood Autism Rating Scale (CARS) (Laila and Nadra, 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 caused by a primary bacterial infection, Mycobacterium avium – subspecies paratuberculosis (MAP). This mycobacterium could spread via cow milk as it is unaffected by pasteurization. Apparently MAP enters the mucosa as saprophytes and only become active when the person is 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 belongs 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 Peptydoglycon recognition protein (PGRP) have a quick and positive effect on the healing process. In addition, immunoglobulin's restore the immune system.

3.1.5. Treatment for allergies

The fact that camel milk lacks β−lactoglobulin, and a "new" β-casein, two powerful allergens in cow milk, makes the milk attractive for children suffering from milk allergies (Makinen-kijunen and Palosne, 1992; Merin *et al*., 2001). β-casein present in cow milk also causes hypersensitivity into humans. Although, camel milk also contains β-casein, but the structure of camel milk protein is very different from the cow milk protein.

According to El-Agamy *et al*., (2009) absence of immunological similarity between camel and cow milk proteins may be taken an important criterion from nutritional and clinical points of view. 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-Kijunen and Palosne, 1992). Phylogenetic differences could be responsible for the failed recognition of camels'proteins by circulating IgEs and monoclonal antibodies. Children with severe food allergies improved rapidly with camel milk. It appears that camel milk has a positive effect in children with severe food allergies. The reactions are rapid and long lasting (Restani *et al.*, 1999).

3.1.6. Anti-cancer and anti-tumor action

Camel's 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) investigated the molecular mechanisms that govern the effect of camel milk on human cancer cells. This study clearly demonstrated that camel milk induces apoptosis in human hepatoma (HepG2) and human breast (MCF7) cancer cells through apoptotic- and oxidative-stress-mediated mechanisms. In addition, camel milk also has antigenotoxic and anticytotoxic effects through inhibition of micronucleated polychromatic erythrocytes (MnPCEs) and improves the mitotic index of bone marrow cells (Salwa *et al.,* 2010). Habib *et al.,* (2013) examines the functional properties of camel milk lactoferrin, the main iron binding protein of the milk which showed 56% reduction of cancer growth.

Camel milk components inhibit the growth of colon cancer cells. Lactoferrin, a glycoprotein has a high affinity for iron and may aid cell proliferation by transporting iron into cells. Lactoferrin has also been shown to have a variety of biological activities, including providing antibacterial activity in infants. It interacts with polysaccharides ligands on cell surfaces and may activate cell signaling pathways such as the Fas pathway, resulting in the inhibition of tumor growth via apoptosis. Lactoferrin can also penetrate cells and function as a transcription factor, activating the transcription of specific DNA sequences. Thus lactoferrin has potential in tumor treatment by blocking tumor cell proliferation. A recent study examined the ability of camel milk lactoferrin to block cancer cell growth. This 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 (≤ 1 mg/ml) (Tsuda and Sekine, 2000).

Tumors can be cured with camel milk; very active antibodies bind onto the tumors, killing the tumor cells without damaging healthy tissue. But human antibodies are too big to do this (Levy *et al*., 2013). It is also revealed that anti-tumor properties of camel milk are due to strong antimicrobial and anti oxidative activities that help in reduction of liver inflammation and camel milk is rich with nutrients that are required for healthy liver function. Conversely, camel milk also shown to have potential thrombolytic action, as it causes inhibition of coagulation and fibrin formation which in turn hinders the spread and growth of metastatic tumour cells (Musaad *et al*., 2013).

3.1.7. Cosmetic and anti-aging effect

Camel milk has cosmetic effect due to presence of α-hydroxyl acids which are known to plump the skin and smoothies fine lines. Alpha- hydroxyl acids help to shed the outer horny layer of dead cells on the skin (epidermis) by helping to break down sugars, which are used to hold skin cells together. This helps in revealing new cells, which are more elastic and clear. Alpha hydroxyl acids helps to eliminate wrinkles and age spots and relieve dryness as they

make the outer layer of the skin thinner and support the lower layer of the dermis by making it thick. In addition, liposome occurring in camel milk is applicable for a potential cosmetic ingredient to improve anti-aging effect (Choi *et al.,* 2013).

Camel milk is good for anti-ageing as the high levels of vitamin C protect collagen. Vitamin C in camel milk has antioxidant and tissue repair protection activities (Salami *et al.,* 2011). 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, joints and cartilage; by increasing the production of collagen. Vitamin C strengthens the structural support and resiliency of skin so 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 higher amount of iron chelating protein known as lactoferrin. This protein removes free iron from joints of arthritic patients thereby improves arthritic (Panwar *et al*., 2015).

3.1.8. Better choice for lactose intolerant people

Camel's milk can be considered an option for the individuals intolerant to lactose who presents symptoms when ingesting cow's milk (Yosef *et al*., 2005; Cardoso *et al*., 2010). Camel milk contained low lactose of small molecules and easily digests and metabolized by the human body (De- Almeida, 2011; Ehlayel *et al*., 2011). Individuals intolerant to lactose are able to accept camel milk without adverse symptoms (Yosef *et al*., 2005). The lactose in camel milk is readily metabolized (Shabo *et al*., 2005).

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 semiarid 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 (Schonfeldt 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 and low intakes of saturated fatty acids and cholesterol are important for the control of obesity, and hypercholesterolemia, 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 increasing the consumption of polyunsaturated fatty acids which are considered beneficial to human health, due to anticarcinogenic, antiatherogenic and immune-modulating 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 Živkovic´, 2007). Camel meat and offal such as liver are believed to have medicinal effects and are eaten raw (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.

Figure 1: A meal of fresh raw camel meat eaten by a group of Ethiopians in a local butchery. The meat is eaten with hot chilli paste.
(Source: Bin Saeed *et al*., 2005).

4. Conclusion And Recomendations

The production of camel milk and meat has gradually increased due to their nutritional and medicinal benefits. Camel milk has valuable nutritional and therapeutic properties as it contains high proportion of antibacterial and antioxidant substances like vitamin C as well as iron in comparison to cow milk. Regular intake of camel milk helps to control blood sugar levels. This also prevents variety of infection including viral, bacterial and cancer. The camel milk also cures severe food allergies and rehabilitates the immune system in children. On the other hand, camel meat is healthier because the carcass contains less fat and has lower levels of cholesterol in the fat than other meat animals. 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 as well as an aphrodisiac.

Based on the above conclusion the following recommendations are forwarded;

- ❖ Further successful clinical evidence should be required with valuable laboratory finding to establish camel milk and meat as the most effective therapeutic agent for treating different disease.
- ❖ Further study should be conducted to confirm the reported low level of organochlorines and certain microorganisms in camel meat compared with other red meats.
- ❖ The consumption and therapeutic use of camel milk and meat should be advocated and practiced in different health care services.

List Of Abbrevations

ACP	Acid Phosphatase
ALP	Alkaline Phosphatase
ALT	Alanine Aminotransferase
ASD	Autism Spectrum Disorder
AST	Aspartate Aminotransferase
CARS	Childhood Autism Rating Scale
CDR3	Complementary Determining Region
CMV	Cytomegalovirus
DNA	Deoxyribonucleic Acid
ELISA	Enzyme-Linked Immunosorbent Assay
GSH	Glutathione
HCV	Hepatitis C Virus
Igs	Immunoglobins
LDH	Lactate Dehydrogenase
MAP	Mycobacterium Avium - Subspecies: Paratuberculosis
MnPCEs	Micronucleated polychromatic erythrocytes
NAGase	N-acetyl-§-glucosaminidase
PGRP	Peptydoglycon Recognition Protein
TB	Tuberculosis
VHH	Variable Heavy Chain
VL	Variable Light Chain
V	Variable
γ-GT	Gamma Glutamyl Transferase

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