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Medicinal and nutritional importance of camel milk: Review

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Abstract

Camels are multipurpose animals they are used for milk, meat and hide supply, as well as for other. Camel milk is unique from other ruminant's milk in terms of composition as well as claimed health effects. Camel milk is full of evenly balanced nutritional constituents and also displays a wide variety of biological actions that influence growth and development of particular body organs, metabolic responses towards nutrients absorption, digestion and fight against diseases. Camel milk is richer in iron, zinc, copper, potassium, sodium, calcium and vitamin C low cholesterol, low sugar than cow milk which makes it closer to human breast-milk than cow milk. Camel milk has potential therapeutic characteristics, such as, anti-diabetic, allergy, autism, hepatitis, and tuberculosis and crhons disease. Camel milk contains higher protective proteins like lactoferrin, lactoperoxidase, immunoglobulins and lysozyme. Camel milk lacks β-lacto globulin which causes allergic reaction. Camel milk provides insulin-like proteins used for the treatment of diabetic mellitus type 1. Camel milk has cosmetic effect due to presence of α-hydroxyl acids which are known to plump the skin and smoothies fine lines.

Keywords: Camel, Milk, Nutrition, Medicine

Introduction

As estimation of Food and Agriculture Organization (2013) the total population of camel in the world is believed to be 25.89 million, of which 89% are one-humped dromedary camels (*Camelus dromedarius*) and the remaining 11% are the two-humped (*Camelus bactrianus*) that generally found in the cold deserts of Asia while more than 60% of the dromedary camel population is concentrated in the arid areas of North East African countries like Somalia, Sudan, Ethiopia and Kenya.(Simeneh *et al.*, 2015). 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 (Abdulwahhab, 2011). It 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. Camel milk is still the most important nutritional source for pastoralists in many Asian and African countries (Valérie, 2007).

Milk is dynamically balanced mixture of protein, vitamin, mineral, fat, carbohydrates, salts, and water co-existing as emulsion colloidal suspension and solution. The average amount of camel milk components is protein 3.1%; fat 3.5%; lactose 4.4%; ash 0.79%, and total solids 11.9%. Milk plays significant role in human's nutrition for the wonderful reason that they are excellent source of various nutrients. Camel's milk in particular is a good source of various vitamins and minerals (Agrawal *et al.*, 2005) and is one of the main components of the pastoral community's basic diet which contributes up to 30% of the annual caloric intake. In addition it is an important source of essential components and vitamins C (Farah *et al.*, 1993). Camel milk is more similar to human milk than any other milk and differs from other ruminant milk because it contains low cholesterol, low sugar, high minerals (sodium, potassium, iron, copper, zinc and magnesium), high vitamin C, protective proteins like as lactoferrin, lactoperoxidase,

Immunoglobulins. Camel milk is full of evenly balanced nutritional constituents and also displays a wide variety of biological actions that influence growth and development of particular body organs, metabolic responses towards nutrients absorption, digestion and fight against diseases (Korhon and Pihlanto, 2001).

Milk has medicinal properties and has been suggested in the management of various diseases. It contains protective proteins, which may have a possible role for enhancing the immune defense mechanism (Farah *et al.*, 1993). It has been reported that camel milk contains the low quantity of β-casein and the lack of β-lacto globulin which cause allergic reaction in lactose intolerant person (Konuspayeva *et al.*, 2009). However, it contains insulin like and protective protein used for the treatment of many diseases like diabetes, autism, hepatitis and tuberculosis and possesses anti-tumors properties (Gul *et al*, 2015). Furthermore, camel milk is endowed with very strong immune system (Grader *et al.*, 2016).

Worldwide, camel milk is not utilized to any significant extent probably due to unawareness of the use, and the market value of camel milk or because of its saltish taste and high acidic nature. However, it is much more nutritious than that from cow milk because it is low in fat and lactose contents, and higher in potassium, iron and vitamin C (Abutarboush, 1996). Various reviews have been done on milk of ruminant but reviews conducted on medical and nutritional value of camel milk were scant. Therefore, the aim of this paper is to compile information on nutritional and medicinal values of camel milk.

Properties of camel milk

Camel milk is generally opaque, white in color and different in taste. Sweet, sharp and salty nature of taste is due to the type of plants eaten in the desert by the camels and availability of drinking water (Khaskheli *et al.*, 2005). Camel milk contains little fat, in average about 2%; and this fat consists mainly of polyunsaturated fatty acids that are completely homogenized and gives the milk its smooth white appearance (Kamal and Abdalla, 2012). It is frothy when shaken slightly and less viscous than bovine milk with average specific gravity of 1.029 (Patel et al., 2016**)**. In fresh camel milk the PH ranges from 6.5-6.7. This pH of the milk allows enhanced absorption of milk constituents from the duodenum, especially the iron. The low pH of camel milk is due to higher concentration of vitamin C. this acidity stabilizes the milk and therefore it can be kept for relatively longer periods without cream layer formation (Khaskheli *et al.*, 2005). The most important property of camel milk is that it can be kept for longer periods than cattle milk when refrigerated and even with the desert heat it does not spoil very soon, and it remains quite stable at room temperature and takes a comparatively longer time to become sour (Dukwal et al., 2007).

Camel milk is a rich source of protein with potential antimicrobial and protective activities. These proteins are not found in cattle milk or found only in minor amounts. The most important one is alpha lacto albumin, which is similar to the enzyme Lysozme, which inhibits the growth of bacteria (Wernery, 2003). Camel milk is not affected by acidic environment and does not form coagulum in acidic environment such of the stomach. Camel milk has high percentage of water content, which ranges from 86-91% and it is inversely proportioned to the availability of drinking water to camels. This makes camel milk a valuable source of water for suckling young camels and the camel herdsmen who are normally live in scarce water areas (Abdalla, 2014). Camel milk has poor coagulation properties, because fat globules are army bound to the proteins. In addition to that fat is distributed as small micelle-like globules in the milk (Eyassu, 2007).

Nutritional worth of camel milk

Camel milk proteins

The main component of milk which has a major impact on its nutritional value is protein. Proteins represent one of the greatest contributions of milk to human nutrition. They perform a variety of functions in living organisms ranging from providing structure to reproduction. Milk proteins are a heterogeneous group of compounds that differ in composition and properties. They are divided into casein complexes and whey protein fractions. These casein and whey proteins constitute a favorable balance of amino acids, comprised of essential and non-essential amino acids in varying concentration. Casein is the most important protein in milk it contains 52-87% of total proteins, while the proportion of whey proteins is relatively low and it is about 1.63-2.76% (Guo et al., 2007).

Caseins are easily digestible in the host intestine and are an excellent source of amino acids for growth and development of juveniles. Currently there are four main casein fractions distinguished: αs1-, αs2-, β-, and κ. their proportion is diverse and polymorphism of these Proteins was demonstrated in most of the animal

species (Barłowska, 2007). The human casein does not contain the αs1-fraction which is the predominant factor causing milk protein allergies. However; it is rich in the β-fraction. On the other hand, casein in cow milk is very abundant in the αs1-fraction (Zicarelli, 2004).

Whey protein of camel milk consists of some other main components such as peptidoglycan recognition protein, immunoglobulins, lactoperoxidase, lactoferrin, lysozyme α-lactalbumin, and serum albumin. The basic whey protein in cow milk is β-lactoglobuline (50%), while in the camel milk it is α-lactalbumin (Kappeler *et al*., 2004).

Camel milk contains the following immune proteins in high quantity; Immunoglobulins: Immunoglobulins are called as antibodies, which are present in human or animal blood serum or body fluids to build body's immunity in response to certain antigens like bacteria and virus. Immunoglobulins are high molecular weight polypeptide chains. The concentration of immunoglobulins in milk fluctuates depending on several factors such as species, health status of animal and stage of lactation (El-Agamy and Nawar, 2000). Camel milk is rich in those immunoglobulin's Immunoglobulins specially IgG and IgA camels. The Immunoglobulins are the same structure as human immunoglobulins but only one-tenth the size. Being so small, they can penetrate into tissues and organs to fight infection and aid repair, where human antibodies cannot. 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. Immunoglobulins give the immune protection to body against infection such as tuberculosis and some other bacterial and viral infection (Mal *et al*., 2006).

Peptidoglycan Recognition Protein (PGRP) was first discovered in camel milk and is very high in camel milk. It stimulates the host's immune response and has potent antimicrobial activity. Studies revealed that PGRP contain an effect on breast cancer. Other important substance found in camel milk is lactoperoxidase; it found in milk, tears and saliva and it has bactericidal activity on gram-negative bacteria like Escherichia coli, Salmonella, and Pseudomonas. Also it has has antitumor activity and growth promotion activity (Hosame, 2013). Lysozyme also available in camel milk and it play a significant role in the innate immune system that targets gram-positive bacteria. Lysozymes participate in many primary immune systems, which are based on targeting of structures common to invading pathogen (Singh et al, 2006).

Camel milk apparently contains much more lactoferrin than in ruminants (cows, sheep, and goats) milk. Iron saturated lactoferrin (from second week of lactation) prevents microbial growth in the gut and participate in primary immune system. (Ueda et al, 1997). Lactoferrin is considered to be an important host defense molecule and has a diverse range of physiological functions such as antimicrobial/antiviral activities, immune-modulatory activity, and antioxidant activity (Wakabayashi, 2006). Lactoferrin found in camel milk is more effective against hepatitis and diabetes thus proving to be a broad spectrum therapeutic, anti bacterial protein. A very striking study on human lactoferrin has shown that it can be used as a diagnostic marker for various cancers. Moreover, it also boosts the host immune response and is also known to have an anti-inflammatory activity (Jagat *et al*., 2015).

Camel milk lipid

Milk fat serves nutritionally as an energy source, acts as a solvent for the fat-soluble vitamins and supplies essential fatty acids. The amount of fat in camel milk ranges between 1.1 and 5.0 per 100 g (Khaskheli *et al*., 2005). Milk fat is found in the form of small fat globules dispersed in milk serum, the diameter of fat globules varies between1.2 to 4.2 micron. And the white color of the milk is due to the presence of these globules; also Camel milk contains smaller amount of short chain fatty acids and lower content of carotene compared to bovine milk which makes it whiter in color (stahl *et al*., 2006). The high state of dispersion of milk fat has a positive influence on the access those lipolytic enzymes to small fat globules. Therefore, milk from camels is more digestible for humans (D'Urso, 2008). Camel milk contains smaller amount of short chain fatty acids and lower content of carotene compared to bovine milk which makes it whiter in color (stahl *et al*., 2006).

Camel milk mineral content

Milk is an important source of mineral substances, especially calcium, phosphorus, sodium, potassium, manganese, chloride, iodine, magnesium, and iron. The main mineral compounds of milk are calcium and phosphorus, which are substantial for bone growth and the proper development of newborns. The high bioavailability of these minerals influences the unique nutritional value of milk. Camel milk is the richest in

these minerals (Al-Wabel, 2008). It also contains higher amount of zinc .The rapidly dividing cells of the immune system are sensitive to zinc deficiency. The role of zinc in the development and maintenance of normally functioning immune system has been well established. The total content of minerals is usually expressed as total ash; this amount varies from 0.60 to 0.90% (Konuspayeva *et al*., 2009).

Iron is important in several biological systems like oxygen transport and storage, and DNA synthesis. Similarly, manganese has an essential role in cellular metabolism for the function of several enzymes (AL-Attas, 2008). Camel milk is a rich source of chloride due to the forage eaten by camels, such as A triplex and Acacia, which usually contains a high salt content that makes the milk saltish in taste especially during dehydration when there is loss in milk components and increase in chloride content (Khaskheli et *al*., 2005). The minerals content of camel are as follows calcium, 114 mg/ 100 g; potassium, 156 mg/ 100g; sodium, 59 mg/ 100 g; iron, 0.29 mg/ 100 g; magnesium, 10.5 mg/ 100 g; manganese, 0.05 mg100 g and zinc, 0.53 mg/100 g (Yagil ,1982).

Camel milk vitamins

Milk is a valuable source of vitamins, both water-soluble and fat-soluble ones (C, A, E, D and B) group. Camel milk is a kind of exception because of its high concentration of vitamin C but less vitamin A and riboflavin. Camel milk contains 5-6 times more vitamin C than cow milk does, this is highly important in desert areas, where fruits and vegetables are scarce. Therefore, camel milk is often the only source of vitamin C in the diet of inhabitants of those regions. The availability of a relatively higher amount of vitamin C in raw camel milk is of significant relevance from the nutritional point as vitamin C has a powerful anti-oxidant action (Haddadin *et al*., 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. Vitamin C is an antioxidant that slows the rate of free-radical damage which causes skin dryness, and wrinkles. Moreover, vitamin C and iron are needed for calcium absorption in cases of osteoporosis increasing the amount of calcium absorbed and deposited in the bone (Levy, 2013).

Camel milk carbohydrate

Lactose is the major carbohydrate fraction in milk and is a source of energy for the young calf and humans. It is made up of two sugars, glucose and glucose, which are fermented to lactic acid when milk goes sour. The lactose content in camel's milk ranges from 4.8% to 5.8% and is slightly higher than the lactose in cow's milk. It seems that the lactose content in camel's milk is relatively constant throughout lactation (Farah and Atkins, 1992).

Generally when compared to cow milk, camel milk is; Lower in lactose, higher in potassium, magnesium, copper, iron, zinc and sodium. Lower in cholesterol, contains three times the amount of vitamin C,has ten times the amount of iron contains higher unsaturated fatty acids and B vitamins, has more Vitamin A, has a higher protein level, Contains ten times the amount of antibacterial and antiviral properties, easily absorbed, It doesn't coagulate easily even in an acid environment like our stomach Hence, it is easily absorbed by our digestive system(Mazlan, 2017).

Medicinal value of camel milk

The camel milk is being consumed for centuries by pastoral peoples due to its nutritional and medicinal properties. Currently, the value of camel milk has increased worldwide due to its high therapeutic value for human health. The medicinal properties of camel milk can be attributed due to presence of protective proteins like, lysozyme, lactoferrin, lactoperoxidase and immunoglobulin's mostly IgA which may possibly play pivotal role for enhancement of immune defense mechanism. Antibacterial and antiviral activities of camel milk proteins have been investigated. In addition camel milk also plays an important role to control number of health disorder such as diabetes, allergy, autism, hepatitis, arthritis etc (Sharma *et al*., 2014).

Anti diabetic mellitus type 1 property

Diabetes mellitus is a disease characterized by abnormally high blood glucose levels, resulting from low insulin secretion or malfunction of secreted insulin (Abdel *et al*., 2016). Diabetes mellitus type 1 caused by autoimmune destruction of insulin-producing beta cells of the pancreas. The subsequent lack of insulin leads to increased blood and urine glucose passing to the blood stream. The use of camel milk by patients with type1 diabetes has indicated that drinking camel milk daily decreases the blood glucose level and reduces insulin requirement by 30%. It appears that camel milk provides an insulin-like protein in a different form than in other mammals and delivers some other therapeutic compounds that boosts

the health of diabetic patients. However, the mechanism is not yet fully understood (Mullaicharam., 2007).

As a unique feature of camel milk, the insulin-like proteins could be protected in the stomach and absorbed efficiently in to blood stream to reach the target. This is because camel milk does not coagulate in an acidic environment and it has a higher buffering capacity than the milk of other ruminants. In addition, since no differences noted in the sequence of camel milk insulin-like protein and its digestion pattern compared to other sources of milk to overcome the mucosal barriers, camel milk insulin-like protein could be protected in the stomach by nanoparticles (e.g., lipid vesicles) to reach the target. Camel milk also contains approximately 52 microunit/ml of insulin-like protein compared to cow milk (16.32microunit/ml) which mimic insulin interaction with its receptor, and it has a higher content of zinc which has a key role in insulin secretary activity in Pancreatic beta cell (Amal, 2015).

The protective effects of camel milk may be attributed to its antioxidant activity and probably has chelating effects on toxicants. It has been reported that camel milk possesses high levels of vitamins (A, B_2, C, and E) and is rich in mineral content (sodium, potassium, copper, magnesium, and zinc). The aforementioned vitamins are antioxidants that are useful in preventing tissue injury associated with toxic agents. In addition, the high minerals content in camel milk may act as antioxidant and there by remove free radicals. Therefore, the daily consumption of camel milk may reduce the risk of diabetes (Powel, 2000).

Wound healing is a normal biological process in the human body. This healing process is commonly classified in to four phases: hemostasis, inflammation, proliferation, and remodeling. A successful wound healing must pass all four phases in the accurate sequence and time frame. Improper or impaired wound healing can occur by certain factors such as desiccation, infection or abnormal bacterial presence, maceration, necrosis, pressure, trauma, and edema (Hess, 2011).

Delayed wound healing occurs in patients with diabetes and is one of the most serious diabetes-associated complications. The main factors for improper or impaired wound healing in diabetic patients are the presence of replicating organisms such as bacteria within the wound. Milk whey proteins accelerate wound healing in diabetics by enhancing the immune response of wounded tissue cells and by alleviating some diabetic complications. Camel milk contains a varied group of proteins such as serum albumin, a-lactalbumin, immunoglobulin, lac-tophorin, and peptidoglycan recognition protein (Kappeler *et al.*, 2004).

Camel milk use for tuberculosis treatment

Tuberculosis is an infectious disease caused by various strains of *mycobacterium*, usually *mycobacterium tuberculosis*. Tuberculosis remains a chronic emaciating diseases affecting socio- economically deprived population. The *tuberculosis bacillus* lowers the immune defense mechanism of the body thus exposing the infected person to an increase risk of developing other diseases. Camel milk contains antimicrobial enzymes (lacteoferrin, lysozyme, lactoperoxidase,) protective protein like stronger immune system and smaller immunoglobulin's than other ruminant milk which may have a possible role for enhancing the immune defenses mechanism. Literatures shown that lactoferrin can act as either a bacteriostatic or bactericidal agent mainly on gram negative bacteria. Lysozymes participate in primary immune system, which is based on targeting of structures common to invading pathogens. Immunoglobulins give the immune protection to the body against infections; Antibacterial properties of these camel milk proteins destroy mycobacterium tuberculosis (Ma *et al*., 2006).

Treatment for crhons disease

Crohn's disease is a condition that causes inflammation of the digestive system or guts that boosts with autoimmune disease. It is commonly accepted that Crohn's disease is an autoimmune disease. However, there are numerous data mentioned that a bovine disorder, Johne's disease, is associated with Crohn's disease via a bacterium, Mycobacterium *avium paratuberculosis*. It has been approved that infection by *Mycobacterium avium* sub specie paratuberculosis lead to a secondary autoimmune response, paving the way for Crohn's disease. The bacteria spread via cow milk as it is unaffected by pasteurization and apparently enters the intestinal tissue as a saprophyte, not creating any symptoms. A very severe emotional stress activates the pathogen and it becomes active in the intestinal tissue. The reaction of the body is to send antibodies to the intestines but as they cannot pass into the thick tissue they attack the intestines themselves, creating an autoimmune disease therefore theorized that Crohn's

disease is primarily a bacterial infection and secondarily an autoimmune disease (Levy *et al*., 2013). Camel milk has shown good effect for treating Crohn's diseases (Reichelt, and. Knivsberg, 2003). 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 PGRP have a quick and positive effect on the healing process. In addition immunoglobulins restore the immune system (yadav, 2015).

Milk allergy treatment

Milk protein allergy is an allergic reaction to proteins commonly found in cow milk. It is caused by the immune system reacting to the milk proteins as they would present a threat to the body. An activated immune system reacts just as it would to a foreign virus or a toxin (El-Agamy *et al*., 2009). Different studies revealed cow milk possesses β–lacto globulin and β-casein (two powerful allergens) which is responsible for milk allergies in children. The milk protein i.e. β-lactoglobulin present in cow milk is highly responsible for allergies in humans. However, camel milk known to be lacking of this (β–lacto globulin) protein and thus do not pose problem of allergies in sensitive individual. 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. Phylogenetic differences could be responsible for the failed recognition of camels, proteins by circulating IgE and monoclonal antibodies. Camel milk is a good substitute for human milk as it does not contain β-lactoglobulin, a typical milk protein characteristic of ruminant milk. Therefore, camel milk may be suggested as a new protein source of nutrition for children allergic to cow's milk (El-Agamy *et al*., 2009; Jan Millehan, 2015).

Another 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. Camel's milk can be used as an option for the individuals intolerant to lactose of cow's milk (De-Almeida, 2011). Camel milk contained low lactose of small molecules and easily digests and metabolized by the human body. Individuals intolerant to lactose are able to accept camel milk without adverse symptoms (Shabo *et al*., 2005).

Autism and camel milk

Autism spectrum disorder is a severe neurodevelopment disorder with onset prior to 3 years of age (Lord, 2000). It is characterized by impairments in social orientation, communication, and repetitive behaviors. In addition to behavioral impairment, it is associated with high prevalence of autoimmune disease, gastrointestinal disease and mental retardation (Bolts, 2002).

Autism is an autoimmune disease (Shoenfeld *et al*., 2000) that surprisingly, attacks the intestines, not the brain (Shabo et al., 2005). Reactions in the intestines are diarrhea, "leaky gut" syndrome, and the effect on appetite ("picky eater"). Sometimes casein breaks down to power full opioid, casomorphine instead of primarily β-casein and β lactoglobulin. This opioid leads to typical cognitive and behavior symptoms due to brain damage (Reichelt *et al.*, 2003). This means that excessive amounts of endogenous or exogenous opioid peptides from food (cow's milk) derived proteins and can be pathophysiology in the autism disease (Dittmer et al., 2007).

Casein proteins are metabolized incomplete in the intestines of some people. As a result, short neuroactive peptides, such as β-casomorphins are formed, which are derived from casein. B-casomorphin has long been considered as a risk factor for autism (Woodford, 2011).This opioid elicits the cerebral symptoms of the autism syndrome. This hypothesis is supported by evidence showing that when dairy products are removed from the diet the "cerebral" symptoms dissipate. This theory emerged when it was found that people with autistic syndrome suffering from diarrhea had normal bowel movements when treated with camel milk as well as improved cerebral symptoms .Camel milk does not contain the two caseins that form casomorphinen from cow milk, so symptoms do not develop, while the active immune system in the camel milk helps ameliorate the autoimmune problems (shabo *et al*., 2005).

Skin disease treatment and cosmetic value

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).

The ingredient's vitamin B, C and iron content are crucial for skin; especially Vitamin C which is found in camel milk in high amount is an antioxidant that slows the rate of free-radical damage which causes skin dryness, and wrinkles (Escott-Stump, 2008). Vitamin C can literally reverse skin aging. The milk contains lanolin and other moisturizing properties providing a calming and soothing effect on the skin. In addition to keeping the skin beautiful used to treat skin disorders such as dermatitis, Acne, Psoriasis and Eczema (Jan Millehan, 2015).

Therapeutic role of camel milk on cancer/tumor

It has been confirmed that lactoferrin has ability to inhibit the proliferation of cancer cell in vitro, and repair of DNA damage (Hosam *et al*., 2013). The main iron binding protein of camel milk, lactoferrin is potent for 56% reduction of cancer growth. This anti-cancer action could be both a direct cell cytotoxicity and anti-angiogenic action (cutting blood supply to tumor cell) of camel milk lactoferin (Habib *et al*., 2013).There are a number of tumors which 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. 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 (Levy *et al*., 2013).

Therapeutic role of camel milk on hepatitis

Scientific publications have shown that camel milk cures both hepatitis B and hepatitis C. The special fat in camel milk soothes the liver and has beneficial action on chronic liver patients (Redwan *et al*., 2007). There is also a possibility that the relatively high concentrations of ascorbic acid in camel milk helps in improving liver function (Gul, 2015). Likewise, various studies have shown that camel lactoferrin markedly inhibits hepatitis C virus genotype 4 infection through preventing the entry of the virus into the cells (Gader, 2016). Additionally, camel lactoferrin is more potent anti-viral agent than bovine and human lactoferrin (Choi et al., 2013).

Conclusion

Camel milk embraces many benefits for the mankind. It is rich in immune globulins and lacks β-lactoglobulin which makes it similar to human milk. Camels can not only lactate under drought conditions but also the quality of milk is very much suitable to human's need. It is high in vitamins (A, B_2, C and E) and minerals (sodium, potassium, iron, copper, zinc and magnesium) and low in protein, sugar and cholesterol. Moreover, camel milk is full of evenly balanced nutritional constituents and also displays a wide variety of biological actions that influence growth and development of particular body organs, metabolic responses towards nutrients absorption, digestion and fight against diseases. Camel milk plays very important role in the treatment of many serious diseases in many parts of the word, because it is rich in numerous bioactive substances like that of lysozyme, lactoferrin, lactoperoxidase, immunoglobulins. Camel milk can be used to treat Diabetes, food allergies, cancer, Hepatitis B and C, Autism, gastrointestinal disorders, strengthen the immune system, tuberculosis and others. Therefore, trend of drinking camel milk should be gigantic and further studies have to be conducted on other roles of camel milk.

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