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REVIEW ARTICLE

Miraculous Properties of Camel Milk and Perspective of Modern Science

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Abstract

Camel has been mentioned in Quran in different places and described a miracle of almighty God. Also, prophet Muhammad (PBUH) has recommend camel in his speech (hadith). The prophet (PBUH) has recommended camel milk for some diseases such as skin disease as remedy. Camel plays in important livestock which produced milk longer than any other ruminant under harsh condition of desert ecosystem. Camel milk is different from other ruminant milk different ways. Camel milk is rich in vitamin C and protective proteins such as lactoferrin, lactoperoxidase, immunoglobulins and lysozyme. Camel milk lacks β-lactoglobulin and used as an option for the individuals intolerant to lactose of cow's milk. Camel milk is extraordinary in terms of antioxidative agents, antibacterial, antiviral, antifungal, anti-hepatitis, anti-arthritis, treatment for paratuberculosis, preventing aging, remedy for autoimmune diseases and cosmetics. Insulin in camel milk is safe and efficacious in improving long-term glycemic control in diabetic patient. Camel milk reduces autism symptoms in children. Lactoferrin has ability to inhibit the proliferation of cancer cell. Camel milk is rich in magnesium and zinc thus could act as antiulcer. Therefore, this review focuses on the composition of camel milk and miraculous and medicinal aspect of camel milk in treating some diseases.

Keywords

Camel milk, Pharmaceuticals miraculous properties milk composition

Introduction

There were 19 million camel's population worldwide according to FAO statistics in which 15 million of them are in Africa and 4 million in Asia. Furthermore, it was estimated that out of this population, nearly 17 million are believed to be one-humped dromedary camels and 2 million two-humped [1]. The camel is an animal can be used for multi-purposes with high productions. In the era that deserts and global warming increasing and scarcity of food and water, camel has ability to face these problems. Despite that, camel can be extraordinary source of milk under these circumstances. In various cultures alongside its benefits as food, camel milk has a long history of use as medicine due to its therapeutic ability which attributes to its components particularly vitamin C [2]. The importance of camel milk in the treatment some diseases such as; malaria, jaundice, gastrointestinal disorder and strong cough (pneumonia) [3] and tuberculosis [4] has been studied and confirmed. This could be due to its many essential nutritional and pharmaceutical components. For instance, presence of insulin in the camel milk could work as anti-hypoglycemic agent regulates B-cells functions [5].

Camel has been mentioned in the Quran and prophets Muhammad (PBUH) sayings (hadith) in different places and mostly as miracles. For example, in the Quran Allah says in the name of Allah, the beneficent, the merciful will they regard the camels, how they are created? (surah al ghashiya, Verse 17). Narrated Abu Qilaba: "Anas said, "Some people of 'Ukl or 'Uraina tribe came to Medina and its climate did not suit them**.** So, the Prophet ordered them to go to the herd of (Mulch) camels and to drink their milk and urine (as a medicine). So, they went as directed and

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Table 1: Chemical composition of camel milk and cow milk [8,9].

Parameters (quantity)	Camel milk	Cow milk
Water (%)	90	85
Total solids (%)	10.00	13.00
Fat (%)	2	4
Insulin (µu/ml)	40.50	16.30
Pantothenic acid (Mg/ml)	0.90	3.80
B-lacto-globulin (Mg/ml)	0	3500
Whey acidic protein (Mg/ml)	157	0
Peptidoglycon recognition protein (Mg/ml)	107	0
B- lacto albumin (Mg/ml)	3500 (Mg/ml)	1200
Kappa casein (%)	5.00	14.00
Casein micelles (µm)	320	160
Whey protein (%)	1.00	0.8
Omega-6 (%)	3.50	5.20
Omega-7 (%)	11.60	2.30

Table 2: Mineral profile of camel milk in different stages [12].

Mineral	Early lactation	Late lactation
Ca	94.06 ± 0.75 mg	97.32 ± 0.51
P	41.68 ± 0.55 mg %	47.14 ± 0.52 mg %
Mg	11.82 ± 0.22 mg %	13.58 ± 0.31 mg %
Na	29.70 ± 0.53 mEq/L	35.49 ± 0.89 mEq/L
K	50.74 ± 0.51 mEq/L	71.86 ± 1.43 mEq/L
Fe	1.00 ± 0.12 mg/dl	-
Zn	2.00 ± 0.02 mg/dl	-
Cu	0.44 ± 0.04 mg/dl	-

after that they became well (Sahih Bukhari, Ablutions (Wudu'), Volume 1, Book 4, Number 234). This could be an example of the miraculous benefits of camel milk at that time.

Overtime science discovers more about camel milk, particularly in terms of medicinal and health benefits, and systematic review is necessary to see more profound and recent discoveries. Since there luck of recent knowledge about camel milk health benefits. Therefore, the aim of the study is to collect and thematic review of present information regarding the pharmaceutical benefits of camel milk in holy Quran and prophet Muhammed (PBUH) sayings as well as the perspective of modern science regarding medicinal benefits of camel milk.

Composition of Camel Milk

Camel milk has a normal odor, opaque white color and salty taste. The chemical composition of the milk is studies by some researchers and presented in the Table 1. Water composed camel milk by 90% and total solid is 10%, Camel milk contains high content of Iron and calcium. Camel milk content is higher in insulin, whey acidic protein, peptidoglycon recognition protein, B-lactose albumin, casein micelles, whey and Omega-7 comparing to caws milk. It has been reported that peptidoglycon recognition protein can role as anti-cancer activity against breast cancer through controlling metastasis [6]. Milk fat is an important component in the milk which determines the nutritional value of milks. Camel milk has lower content of fat comparing to cow and human milk. Also, it has been reported that the fatty acids in camel mostly composed of long chain polyunsaturated fatty acids (C14-C18) than short chains (C4-C14). This could be very useful of the body health. Furthermore, camel milk fat is completely homogenized with the smallest globule's diameter around 2.99 µm which imparts a smooth texture to the milk [7-9].

Table 3: Enzymes present in camel milk [3].

Enzymes	Activity (IU/L)
Aspartate amino transeferase	7.98 - 9.21
Alanine transeferase	9.49 - 11
Gamma glutamyl transferase	254 - 296
Acid phosphatase	2.74 - 3.08
Alkaline phosphatase	16.04 - 24.93
Lactate dehydrogenase	132 - 168
Catalase	0.083 - 0.193 moles/min/g of protein

Table 4: Vitamin content of camel milk [14].

Vitamins	Quantity
A (µg %)	20.10 ± 10.00
E (µg %)	32.70 ± 12.80
B1 (mg %)	19.60 ± 6.40
Pantothenic acid (Mg/ml)	0.90
Niacin (mg/ml)	4.60
Vitamin C (mg/ml)	35.00

It can be seen from Table 2 the mineral content of camel milk in two stages of lactation. It is obvious that quantity of the minerals increased at later stages. Camel milk contains reasonable amount of It Iron and calcium and high acid due to vitamin C and decreases pH [10]. This can ease the nutrients absorption in the intestine. It has been reported that that camel milk Furthermore, it contains Zinc which play an important role in the maintenance and improvement of immune system. Also, it has been reported that camel milk possesses higher amount of trace minerals comparing to other mammalians [11,12].

The enzymes and their activity in the camel milk are presented in the Table 3. It can be seen that the highest enzymatic activity is Gamma glutamyl transferase and Lactate dehydrogenase by 132 to 168 and 254-296 IU/L respectively. Whereas the lowest quantity of enzymes found is catalase by 0.0083-0.193 moles/min/g of protein. Some of the enzymes can be utilized as an indicator to ensure the quality of the milk. But this could be different in milk sources. For instance, in cow milk Alkaline phosphatase is used an indicator for proper pasteurization since it is deactivated at 72 °C. whereas, in camel milk Gamma glutamyl transferase is used for quality of the heat treatment as it is destroyed at 72 °C for up to 20 min [13].

The level of vitamins present in the camel is presented in the Table 4. Camel milk contains both soluble water-soluble and fat-soluble vitamins in different amount.

The vitamins A and E seems to be low comparing to the cow milk. Furthermore, B-carotene is high (99.6 ± 62.0 µg %) in cow milk and it is not found in camel milk. It has been reported that vitamins A, E and B1 is higher in camel milk colostrums than milk of mature milk. On the other hand, camel milk is a unique source for vitamin C comparing to other mammals. It contains two to three times more than cow milk does [14]. This makes camel a significant animal in the desert for as source of vitamin C where other sources of the vitamin are scarce difficult to plant. Consequently, camel is an evitable source of the vitamin in population diet in these areas [15]. This is can act as anti-oxidant agent and increase the shelf life of the milk.

Pharmaceutical Impact

Anti-microbial activity and immune system

Camel milk contains different immune proteins molecules which can combat different microbes and act as protective agents [16]. Immune system of camel milk possesses IgM, IgG, IgA and even IgD have been found [17]. 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 absence of the VL conventional antibodies rarely show a complete neutralizing activity against enzyme antigens [18]. Camel VHH domains are better suited to enzyme inhibitors than human antibody fragments, thus offering a potential for viral enzymatic neutralization [19]. Immunoglobulins in the milk can fight some bacteria like tuberculosis. Furthermore, it can protect the body from bacterial and viral infections. Camel milk also contains lactoferrin and its activity is ranged from 95 to 250 ml/dl (more than other ruminants) which can inhibit the growth of infectious microbes and takes part in the immune system [20]. Furthermore, presenting lactoperoxidase with activity ranging from 2.23 ± 0.01 U/ml of milk could role as anti-microbial activity particularly on gram negative bacteria [21]. Some researchers have found that camel milk has beneficial influence on tuberculosis and especially individuals suffering from multidrug resistance [22,23]. In a study about pasteurized camel milk, the results found that camel milk exerts antimicrobial activity against foodborne pathogens (*Listeria monocytogenes* and *E. coli* O157:H7). Furthermore, it was observed that the pasteurization has no effect on antimicrobial activity [24]. Anti-microbial activity of camel milk has been proved in many studies [25-27].

Camel milk in treating diabetes

Camel milk can be recognized by low level of fat and cholesterol, inclusion of vitamins and minerals and important source of insulin. It has been reviewed that camel milk can be useful for treating diabetes [28,29]. The level of insulin in camel milk was determined to be around 32 µU/ml which is much more comparing to other bovines, but this is could vary considering lactation stages. In 2005 a group of researchers at Bikaner Diabetes Care Research Center in India investigated the impact camel milk on the control of type 2 diabetes, they found that the consumption f the milk significantly reduced insulin-doses needed to control glycemic and blood glucose. It has been reported that camel milk can be used to treat type2 diabetes since it contains a significant amount of insulin [30]. Therefore, camel milk can be utilized as adjunct to insulin treatment to treat type 2 diabetes in order to reduce the dosed of insulin especially when it is safe and efficient in long term diabetes controlling [31,32]. In a study about ant-diabetic properties of came milk and in animal experiment, it was found that after three week of camel milk consumption by alloxan-induced diabetic dogs the level of blood glucose reduced from 10.88 ± 0.55 to 6.22 ± 0.5 mmol/l [33]. Anti-diabetic properties of camel milk was investigated on streptozotocin-induced diabetic rats .In a study about the prevalence of diabetes among the population consuming camel milk, it has been stated that consuming camel milk and life style could have substantial influence of prevalence of diabetes in any populations [34]. It was found that the effect of eating camel milk daily rate for patients with diabetes type II works to adjust the level of insulin in patients due to the increase in the ratio of serum insulin, lipid profile and blood pressure and back due to differences and diversity in the composition of milk from the fatty acid, protein (casein), is the content of the hand in the form of large granules act to prevent digested Boisson stomach enzyme pepsin and insulin molecules that prevent her from association with receptor because of their small sizes [35]. In a long-term study was done about the potential and safety of camel milk to adjunct insulin therapy in type 1 diabetes diagnosed patients. The study was conducted with two different animal groups in a randomized clinical land parallel. The first group received camel milk and usual care including diet, exercise and insulin and the second group received insulin and usual care. The results revealed that the blood glucose in the first group decreased as well as hemoglobin and insulin requirement. Even in some participants the need for insulin dose reached to zero. But plasma insulin and insulin antibodies did not undergo significant changes in both groups. This could suggest that camel milk could be safe and efficient in a long-term glycemic control and decreasing need for insulin doses in patients with type I diabetes [36]. A conventional treatment of juvenile diabetes was compared with camel milk drinking treatment. The results showed that drinking camel milk had significant decrease in blood glucose and Hb level. Also, the amount of received insulin was also decreased [37].

There are a number of possible suggestions regarding the insulin of the camel milk; firstly, insulin of the camel milk possesses special traits that make absorbed easily into circulations comparing to other sources. Secondly, insulin from camel milk is lipid- capsulated that makes it enable to pass through digestive system to be absorbed into blood stream. Thirdly, presence some other elements in camel milk imparts anti-diabetic traits to it [38].

Camel milk and anti-cancer

Studies have shown that camel milk works to combat and eradicate the cancer cells (HepG2-MCF7), because camel milk contains high levels of lactoferrins, immunoglobulins and iron - binding glycoprotein. These components act as antitumor and which happens through increasing RNA synthesis and the inhibition of protein kinases and differentiation. It has also been reported that camel milk contains lactoperoxidase which possess anti-tumor activity. Inclusion of peptidoglycon recognition protein in the milk was firstly found in camel milk which can fight breast cancer through of take over metastasis [39]. The influence of enzymatic hydrolysis and digestive of casein from camel milk and beta casein on their antioxidants and angiotensin converting enzyme inhibitory traits was studies. The results revealed that when camel milk is drunk and hydrolyzed, the generated peptides can role as natural antioxidants and angiotensin converting enzyme inhibitors [40]. In an animal designed experiment, the influence of camel milk consumption on the promotion and proliferation of cancer hepatoma (HepG2) and human breast (MCF7) cancer cells was observed. The outcome of the study showed that camel milk significantly inhibited the proliferation of the cancer cells via activation of caspase-3 mRNA [41]. Camel milk can protect body from proliferation of cancer cells by 50% at 5 mg/mL and exerts antioxidant DNA damage inhibitory activity [42]. Very recently some researchers stated that camel milk can inhibit the tumor and malignant cells of a number of cancers such as hepatocellular carcinoma, colon carcinoma, human glioma cells, lung cancer cells and leukaemic cells [43]. The anti-carcinogenic properties of camel milk could be due to a number of reasons. Firstly, the antibodies of camel milk are very active and able to bind to tumor cells and kill them with keeping healthy cells undamaged [44]. Secondly Possessing strong anti-oxidant and antimicrobial activity by camel milk, enables it to reduce the inflammation of liver and healthy functioning of liver. Additionally, camel milk proved to have thrombolytic activity which inhibits the coagulation and formation of fibrin consequently hinders the metastatic tumor cells to growth and spread [45].

Camel milk and anti-inflammatory activity

Camel milk can also be used as anti-inflammatory effect against a number of infectious diseases. Furthermore, it contains vitamins like C, A, B2 and high level of vitamin C and rich in zinc and magnesium. They could be very essential to diminish the toxic and oxidative stress effects of some agents [46]. Particularly magnesium which aids vitamins metabolism, biosynthesis of glutathione which is important protects cell damage by toxic agents and enhances antioxidants defense [47]. Camel milk can be used as anti-diarrhea medicine. Some researchers studied the effect of camel milk in the treatment of diarrhea. It was revealed that camel milk possesses (lactoperoxidase, peptidoglycan, lactoferrin and lysozyme) and these proteins work with antibodies against rotavirus diarrhea [48]. Also, it was found that camel milk contains substances that work on eliminating hepatitis C virus. Since camel milk contains casein (alpha - lacto albumin) which links HIV and begin the process of apoptosis of this cell from any effect on human cells [49]. High content of vitamin C potentially help improve liver function [50]. The antibodies in the camel milk are specific and selective controller to virus systems. This could refer strong resistance to dangerous animal viruses [51]. The presence of large viral antibodies in the camel serum and milk indicates attaches by viruses but not infected [52]. It has been reported that large antibodies cannot reach targets and combat enemies. Therefore, camel milk antibodies are much less small than humans which about tenth of the size of human antibodies. This makes simplicity and more affinity enables camel antibodies to penetrate depth of the tissue and reach the targeted antigens [53]. It has also been stated that camel milk bioactive peptides may exert anti-microbial, anti-oxidative, anti-hypertensive, anti-inflammatory, and immunomodulatory activities [54]. On the other hand, more recently a study suggests that camel milk lactoferrin inhibits the entry of the virus into the cells [19]. The anti-viral activity of camel lactoferrin is very powerful which can even inhibit *Schistosoma Mansoni* [55].

Camel milk and autism

Autism is life-long neuro-development malfunctions characterized by luck of communication and social interaction [56]. It has been found that camel milk can be used as a treatment for autistic patients by reducing oxidative stress rate is due to contain high number of antioxidants in the form of vitamins, including A, C and E and other minerals such as Mg and Zn. Furthermore, these minerals stimulate glutathione manufacturing, have been found containing antibodies equal to the size of immune antibodies in humans, which in turn is working to develop autistic behavior [57]. It has been reported that oxidative stress plays a crucial role in some neurological diseases; autism for instance. Recently camel milk has showed therapeutic potent impact on autism. In a study to find a potential association between camel milk consumption and reduction of oxidative stress with autistic behavior in children, the study found that after two-week consumption of camel milk, the level of glutathione, superoxide dismutase, and

myeloperoxidase in plasma were significantly increased. The study proposes that camel milk intake could be significantly important to decrease the oxidative stress through changing the concentration of anti-oxidative enzymes non-enzymatic anti-oxidants molecules, hence reduced the signs of autism in children [58]. Also, lower content of B-casein, lack of B-lactoglobulin and presence of protective protein make camel milk suitable for to maintain immune system and brain development [59]. It has been stated that autism is among the diseases that has successfully healed with camel milk [60].

Camel milk and skin diseases treatment

The influence of camel milk consumption and its effect on the skin has been of concern of researchers. Presence of vitamin C in the milk imparts antioxidant skin tissue protective activities. Vitamin C is also necessary to produce collagen protein as it helps the growth of cells and blood vessels and consequently imparts strength and firmness to the skin. Vitamin C also protects the skin from free radicals which causes some skin problems such wrinkles and dryness [45]. Furthermore, it has been reported that following to camel milk consumption, the protein is digested, and bioactive peptides are generated. This peptide act as natural anti-oxidants and ACE inhibitors [40]. In a cosmeceutical study about camel milk, it has been concluded that the milk contains skin friendly and anti-aging agents which make skin tissue feel comfortable [2]. That's why Prophet Muhammad (PBUH) recommended camel milk for the treatment of skin as mentioned in the introduction. This is the miracle of prophecy. Since without having knowledge, he recommended that.

Camel milk and Cohn diseases

It is called Crohn syndrome, a kind of inflammatory syndrome that could affect any place from mouth anus. It causes several symptoms such as weight loss, stomach pain, vomiting or diarrhea. It could also some more health problem complication such as inflammation of the eye, tiredness, and lack of concentration, skin rashes and arthritis. This disease is mostly caused by factors from environment, immune system and microbial. Particularly, microbial factor by mycobacterium avium-subspecies, paratuberculosis in cow milk uncontrolled by heat treatment. Camel milk has been used and suggested to treat Crohn diseases. It has been stated that since this bacterium is from tuberculosis family and camel milk can be utilized to treat this bacterium. It is obvious it can be treating with camel milk due to having bactericidal properties if camel milk with peptidoglycon recognition protein can combine to heal the disease [61]. Study conducted on the effect of camel milk on multiple drug resistance patients with tuberculosis concluded that camel milk can act as an adjuvant nutritional supplement in multiple drug resistance patients [8].

Conclusion

To summarize, camel milk has been mentioned in verses of holy Quran and hadith of the prophet Muhammad (PBUH) as miracle and its milk was recommended to treat diseases in his era. Camel milk is different from other ruminant milk different ways. Camel milk is rich in vitamin C and protective proteins such as lactoferrin, lactoperoxidase, immunoglobulins and lysozyme. Camel milk lacks β-lactoglobulin and used as an option for the individuals intolerant to lactose of cow's milk. Therefore, camel milk is extraordinary in terms of antioxidative agents, antibacterial, antiviral, antifungal, anti-hepatitis, anti-arthritis, treatment for paratuberculosis, preventing aging, remedy for autoimmune diseases and cosmetics.

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