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Review paper

A Comprehensive Examination of Camel Milk: Composition, Nutritional Attributes, and Therapeutic Significance

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ABSTRACT

The camel milk is the most important and commonly used food in the tropical and subtropical regions of Asia and Africa. Camel is a significant animal that contributes to social persistence of arid and dry agroecologies. Camel's products like milk, meat and urine has therapeutic value for different human diseases especially in the pastoral societies. Mammals produce milk in the mammary gland lacteal secretion. As it is obvious, milk is natural food young mammals. Among all lactating animal in the nomadic people, camel is one of the most appreciated mammal by producing highly nutritive and therapeutic milk. Camel milk has essential elements such as minerals, vitamins, fatty acids, carbohydrates and protective proteins like immunoglobulins, lactoperoxidase, lactoferrin and lysozme. Moreover, camel milk comprises small sized protective proteins or immunoglobulins which can fight diseases, through penetration of antigen body and increasing the efficiency of the resistance of diseases like, dropsy, jaundice, spleen ailments, tuberculosis, asthma, anemia, autoimmune diseases (autism), constipation, crohn's diseases, liver cirrhosis and also serve as beauty goods. Since, camel is native and well known among the pastoral society; they have indigenous information in treating themselves and their domestic animals using camel milk, as they are existing at distant zone where community services are in scarce or even absence and hence, they depends on traditional medicines. Camel milk is among the items used as traditional medicine in pastoral communities. The objective of this paper is to review the medicinal value of camel milk.

1. Introduction

Camelids were probable among the last major domestic species domesticated by human being before 4000 years or slightly earlier. The southern Arabian Peninsula, Yemen and Oman are almost certainly recognized area of the domestication. Arabian camels (Camelus dromedarius) are capable with extra-ordinary features that enable them best adapted to survive and accomplish to harsh surround-ings and fluctuation of nutritional conditions of harsh ecological circumstances (Takele, 1991). Camels are multipurpose existing properties that safeguard food security even throughout the dry periods and also help as sources of movement in most uninviting zones of the world, so called as "ship of the desert", characterized by an essential security for transportation and draught power (Yagil, 1985; Higg-

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-ins et al., 1992).

The distributions of camels are highly influenced by environmental, cultural and social factors. The most suitable ecology for the distribution of camels is tropical and subtropical zones of Africa and Asia. According to different source of information, Eastern Africa is known to be the heartland for camel population, as 80% and 63% of the Africa and world population, respectively produced in the region. In these regions Somalia, Kenya, Ethiopia and Djibouti are the principal countries by camel production (Wilson, 1998). In Ethiopia, camels are found in northeastern and southeastern arid and semi-arid zones. In the country, the most important ethnic clusters possessing camels are the Afar, Beja, Borana and Somali (Workneh, 2002).

Camels are an important source of milk, meat, hides, wool and their dung's is used for fertilizer and as a fuel. They are also used for riding, draught power and transportation as a means of investment and long- term savings as a source of prestige for their owner and there is a large market for trade in live camels. Camel products like milk, meat and even urine has therapeutic values for different human diseases. In African country, production and utilization of camel milk has been taking place for many centuries ago. In recent times camel dairy products has been gotten substantial attention especially in South East Asian countries. According to various study reports, camel milk is a noble source of nutritious, vitamin C and protein in addition to comprising much more therapeutic value when compared to the milk of any other animal. Moreover, relatively camel milk stays fresh for long time as compared to cow's milk. As Inayat et al., (2005) stated, during drought period camels remain to lactate long after any other domestic mammals have stopped.

Milk is obtained from mammary gland of mammals though lacteal secretion. As it is well known, milk is the first natural food of young mammals during the period immediately after birth. Human has been started using milk and milk products as a food before development ongoing. Currently, camel milk is gaining more acceptances due to its high nutritional assets and therapeutic importance (Strasseret al., 2006). In the nomadic society, camel milk is one of the most valuable food resources since it comprises all vital components. It has essential content which is very important for health and growth. Among the contents of camel milk protein, vitamins, minerals and calcium are the well-known elements. The taste of camel's milk is somewhat salty than cow's milk, however it comprises lesser saturated fat and approximately three times of vitamin C and up to ten times more iron when compared to cow's milk (Yagil and Etzion, 1980).

Although, the type of fodder and availability of drinking water cause the changes in taste of camels' milk, it is impervious white and has a sweet and sharp taste and has a low PH owing to its high volume of vitamin C concentration. A variety of foodstuffs are made from camel's milk such as butter, cheese, ghee, khoa and sour milks (Farah, 1996). The unique features of camel milk are its healing value of various human infections. The nomadic area societies suggest that milk of camel used to treat a number of diseases in human beings. The camel milk is understood to be very important for children as of the belief that it is not only make healthy, but also well in bone formation and it has been used to treat infections such as chronic disparity of the liver, like oedema swelling of the belly and jaundice. According to different investigation report, unpasteurized camel milk encompasses insulin-like proteins that can bypass the abdominal and can be immersed together. Therefore, such typical features possibly will subject camel milk to aid and regulate diabetes (Alemayehu, 2001; Agrawal et al.,2005). As the camels consume varies bushes and shrubs that are used in provision of medicine, a lot of internal illness can be treated by consumption camel milk (Kappeler et al., 2003).

2. Composition of Camel Milk

Due to the composition varieties camel milk, it has the major significance for human. The composition can be influenced by the stage of lactation, age, and the number of calving's. Most of camel milk is drunk fresh and also consumed when slightly sour or strongly soured. The feature of camel milk is extraordinary during the camel is highly desiccated in the intermediate of hot summer when water is scarce due to change that occurs in the quality of milk (Yagil and Etziion, 1980). During dry session when drinking water is limited, the camel secretes highly diluted milk with a low fat content, while the cow, ewe, and nanny goat all secretes concentrated milk (Singh, 2001). The PH of camel milk is similar to the pH of sheep's milk which ranges from 6.5 to 6.7 with an average value of 6.56, the acidity increase rapidly when stayed or stored for a particular time. The

average density of camel milk is 1.029 with the range value of 1.025 to 1.032. The lactic acid content increases from 0.03% after staying 2 hours to 0.14% after 6 hours. The colostrum has a white color and somewhat thinned than the colostrum of cow (Yagil and Etzion, 1980).

The total solid declines from the post-partum up to first 2 days of lactation, typically from 30.4% to 18.4%, as a result of initially the fat proportion was low, which is 0.2 %, and then significantly greater than before 5.8 %; relatively the decline in entire proteins and minerals are accountable for the decrease of total solid. Camel milk has less specific gravity when compared to buffalo, cow and sheep milk (Shalash, 1999). Moisture and protein have been found to be higher in camel milk compared to cow milk. Comparative low percentages of total solids and fat in camel milk have definite positive benefits of drinking camel milk over cow milk. Post-partum changes in gross chemical composition of camel milk showed an increase in fat from 0.10 to 3.78, while protein decreased from 17.62 to 2.66% after 27 days of parturition (Singh et al. 2006). The higher ash contents during late lactation suggest that camel milk can provide a satisfactory level of minerals (Mal et al., 2007).

2.1 Water

Water content has great influences that can affect the whole composition of camel milk. As a result of many investigation, It has been evidently confirmed that ristricted from drinking water is reason for rises of water content and consequent in reduction total solid. According to the report of Yagil and Etzion, (1980) desiccated camels that drink water only once a week secrete milk with over 90% water content and only 1% fat.

2.2 Camel milk proteins

The composition protein and nitrogen content camel milk is mostly similar to cow milk. But, in the camel milk, the average value of protein and casein contents is ranges from 0 .7 to 1.0% and 1.9 to 2.3% correspondingly. This indicates that the nitrogen amount of casein is slightly higher in cow milk which ranges from 77 to 82% of total protein nitrogen as compared to camel milk with 71 to 79% (Farah, 1993). The crude protein of camel milk casein and their portions are lower in than with cow milk (Pant and Chandra, 1980). Also comparatively, the quantity of whey proteins is lower (0.7 to 0.8%) in cow's milk than (0.9 to 1.0%) in camel milk. On the other hand, the heat stability of camel milk whey protein was found to be significantly greater when compared to cow's milk (Farah and Ruegg, 1998).

2.2.1 Protective proteins

The protective proteins achieved in camel milk are peptidoglycan recognition protein (PGRP), lactoferrin, lysozyme, lactoperoxidase and diverse enzymes. Relatively, the colostrum's of camel milk comprises greater concentration of lysozyme and lactoferrin than cow's milk (Wernery, 2007). Immunoglobulin's gives the immune defense to the body against infections and attack the anti-DNA to reestablish the immune system (Urazakov et al., 1994).Thelysozymes have a huge role as they are mainly contribute in immune system, which is established on targeting to attacking pathogens. The concentration of level lysozyme ranges from 0.03- 0.65mg/dl The high concentration of lysozyme in camel milk is important for the storage of milk for a long time without spoiling (El-Agamy and Khatab, 1999; Singh et al. 2006).

In the primary immune system lactoferrin prevents microbial growth in the gut starting from second week of lactation. Moreover, the lactoferrin in camel milk has antibacterial, antiviral and anti-tumor properties. The concentration of lactoferrin in camel milk is 95-250mg/dl (Morin et al., 1995). Also, lactoferrin is well known to have antioxidant properties and also prevent cancer development through binding with iron and inhibiting DNA damage (Hosam et al., 2013). The lactoperoxidase is commonly found in saliva, tears and milk. It has good role in antibacterial activity especially on gram-negative bacteria and give rise to the non-immune host defense system. In addition, it has a growth promotion activity. Due to its close relation (71%) to human thyroid peroxides, it involved in iodination and coupling in the establishment of the thyroid hormone in human (Ueda et al ., 1999).

In the camel milk, the concentration of peptidoglycan recognition protein enzyme is extraordinary. The PGRP has deceptive result on regulating metastasis in breast cancer. The enzyme has an extensive anti-microbial effect and motivates the host's immune response (Kiselev, 1998).

2.3 Fat

The camel milk fat is has special characters that when left standing and distributed as minor globules throughout the milk. The fat globules are very small 1.2–4.2 microns in diameter (Yagil and Etzion, 1980). The appearance of fat globule has thicker membrane than in that of other types of milk. As a consequence of camel milk fat is appears to be bound to the protein, it is challenging to remove fat by means of usual technique of churning sour milk. Moreover, camel milk fat has a specific factor such as, a high percentage of long-chain fatty acids and low percentage of short chain fatty acids. Depending on the feeding conditionsand breed camel there is variation on fat content which ranges from 2.7% to 3.6%. In camel milk fat the shortage of agglutinin results in a very slow creaming characteristics rate at any temperature (Farah and Ruegg, 1998).

2.4 Vitamins

Among the vitamins recognized in camel milk, vitamin C is found in very enormous amount. Accordingly, in the regions where vegetables and fruit are limited, this is essential in the nutritional standpoint. The vitamin C content of camel milk is depend on lactation progresses or synthetic activity in the mammary tissues during early phase of lactation that declined as lactation advanced. The vitamin C levels are ranges amid 5.7 to 9.8-mg/l, this high level of vitamin C is relatively one-and-a-half that of human milk and three times than that of cow milk (Knoess, 1995). The camel colostrums have a higher level of vitamin A, B2 and E than mature camel milk. The high vitamin C content results in low pH which allows camel milk to be kept for comparatively longer periods (Stahl et al., 2006).

2.5 Minerals

The capacity of mineral deposition in their milk is diverse and depends on breeds. Camel milk has a higher amount of trace minerals such as copper, iron, and zinc than to cow milk (Wangoh et al., 1998). Camel milk contains 10 times higher iron than cow milk, which essentially contribute in several of biological systems like DNA synthesis, oxygen carrying and storage. Wonderfully, from dehydrated camel milk the concentration of sodium and chlorine increased while the concentrations of fat, calcium, phosphorus, magnesium, protein and lactose content showed decrease. Owing to the reduction on concentration of various mineral in the milk of dehydrated camel, camel milk is resulted for the salty taste (Yagil and Etzion, 1980).

3. Nutritive Value of Camel Milk

Nutritional composition of camel milk is an outstandingly dietary to human's and, has much preventive effect on infectious disease. The milk structure of camel is exceptional from a dietetic viewpoint (Gran et al., 1995). It comprises components like, ash, carbohydrate, calcium lactose, vitamins (A, B2, E & C) cholesterol, fat, natural & added fiber protein, lactic acid, lanolin, sugars and minerals (calcium, iron, magnesium, potassium, sodium and phosphorus). Camel milk contains a high level of copper, iron, magnesium, manganese, sodium, potassium and zinc and encloses high amount of antibacterial ingredients which makes a appreciated nutritional assets (Sawaya et al., 1984).In the lack of refrigeration facilities in milking and transporting, camel milk can be consumed in the raw state without any heat treatments and can be kept at high temperature without spoiling. As, Barłowska et al., (2011) report showed that camel milk has properties that it can be kept for extensive periods than cow's milk without refrigeration in hot desert. From composition itself, it can be very well estimated how nutritious camel milk is. Camel milk is enormously beneficial and unconditionally harmless for feeding. It is supposed that individuals who consume camel milk on a consistent origin are a smaller amount susceptible to suffering from body ailments. Moreover, existence with a high amount of vitamins and proteins was increased its being perfect nutritional supplement for malnourished children and adults. Camel milk has vitamins A and some B groups as a key vitamin and also contains essential minerals like K, Zn, Mn, Cu Mg, Na, and Fe. The presence of Na in camels milk renders its salty appearance (Walstra et al., 2006).

The vitamin C content is 3 times and Fe is 10 times higher, while lactose and fat content of camel milk is much lower when compared to cow's milk. Its dietary value is improved with the existence of polyunsaturated linoleic acid and fatty acids additional volatile acids. Having camel milk frequently can build up immune system as existence of immune factors in its milk. Camel milk also contains specific antimicrobial elements, which are indeed useful for the body. The significance is specified to improve

source of camel milk, only due to its extremely high nutritional value (Saptaktee, 2012).

4. Therapeutic Value of Camel Milk

According to various investigation outcomes showed camel milk is nearer to human milk than any other milk so lactose-intolerant individuals frequently simple to digest it. Camel milk is rich in healthy vitamins and minerals, especially B vitamins, vitamin C and iron. Camel milk encloses immunoglobulins against infectious disease, which are minor in magnitude, permitting dispersion of antigens and boosting the efficiency of the immune system. Camel milk have lower cholesterol, sugar and higher protein and minerals (copper, iron, sodium, potassium, magnesium and zinc), and high vitamins A, B2, E, and C compared to cow milk and larger concentration of insulin (Agrawal et al., 2004).

5. Traditional Medicinal Value of Camel Milk

In the Middle East countries it is understood that regular consumption of camel milk aids in the inhibition and control of many autoimmune diseases. Many authors also recently proved this property of camel milk. In many countries pastoralists have native awareness in treating themselves, their child and their animals. Because, limitation of social services at periphery and remote area pastoralists, they depend on traditional remedies. Among the materials used as traditional medicine camel milk, meat and urine are the wellknown. As most of pastoralists stated that, camel milk is greater to milk of other species of ruminants and they give numerous explanations for the favorite of camel milk than the milk of other mammals. Cow's milk tends to cause obesity however, camel milk provides power, durability and energies and this is characteristic that pastoralists requisite in order to follow a nomadic lifestyle (Rihab et al., 2008) Unlike cow's milk, camel milk has medicinal values and can be used to treat a quantity of disease in human beings. Also, the pastoralist believes that camel milk retains for a extended time; it has great nutritional value containing higher level of vitamins, at ease to digest and satisfies thirsty. Camel milk in pastoral area is manly consumed in its raw state without pasteurization (Yagil, 1982).

6. Conclusion and Recommendations

Generally, camel milk is the chief source of food for pastoralists, neonate calves and offers all important nutrients for growth and development like, carbohydrate, fatty acid, vitamins, minerals, growth factor, immune modulators , serum albumin, lacto albumin, lactophorin, protective proteins like immunoglobins, lactoferrin, lactoperoxidase,lysozyme and PGRP as well as also it contains high moisture content. The nutritive value of camel milk is estimated from its components. Camel milk is tremendously beneficial and completely harmless for consumption and also has a high therapeutic value. When paralleled to bovine milk, a camel milk whey protein encloses a advanced content of antimicrobial factors. It is understood that individuals who drink camel milk on a consistently are fewer predisposed to illnesses like autism, diabetes, crohn's diseases, hepatitis B and C, TB, constipation, tumor and other immune disorder. Conventionally camel milk has been used for the treatment of disease like tuberculosis, diabetes mellitus, jaundice, asthma, hepatitis, constipation, snake venom, dropsy, anemia etc by pastoral communitiesdue to its antimicrobial and other properties.

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