



## **Article Review: Camel Milk as an Amazing Remedy for Health Complications: A Review**

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**Abstract:** Camel milk has unique benefits for human health. Protein is the main component which gives special properties to camel milk and effectively influences its nutritional value. Due to lack of  $\beta$ -lactoglobulin in the camel milk, it may be as a proper alternative for human milk. Camel milk is rich in vitamins C, manganese and iron. There are high amount of unsaturated fatty acids, immunoglobulin's, insulin like protein and protective enzymes like lactoferrin and lysozyme in the camel milk. The lactoferrin has the effects or properties of antibacterial, antiviral and anti-inflammatory. Also, it has been proven that camel milk has beneficial application in disorders of stomach and intestinal, food allergy, diabetes mellitus, cancer, autism, and viral hepatitis. Camel milk containing insulin like protein and may help to heal diabetes of Type 1 and 2 and gestational diabetes. It contains small size immunoglobulins which strengthens the immune system. In addition, camel milk reduces blood cholesterol amount, avoiding of psoriasis disease, healing of inflammation and improving of tuberculosis patients. Camel milk may be effective as unique miracle in many healthy issues of human and especially cardiovascular system. Therefore, it is not only food, but also it is as amazing remedy for treatment and healthy issues.

**Key words:** Camel milk, Health, Lactoferrin, Medicinal values.

### **Introduction**

Camel milk as a unique source of nutrients and vitamin C, prepares about 30% of the annual calorie in the diet of pastoral community (Farah *et al.*, 1993). Camel milk contains fat, cholesterol, and lactose of camel milk is lower than bovine milk, but minerals such as calcium, magnesium, iron, copper and zinc, and vitamins A and C are greater than bovine milk. It contains no  $\beta$ -lactoglobulin and low  $\beta$ -casein

which are the allergic proteins in cow's milk (Shabo & Yagil, 2005). Protective proteins of camel milk including lactoferrin, lactoperoxidase, lysozymes, immunoglobulins, N-acetyl- $\beta$ -glycosaminidases and peptidoglycan recognition protein have therapeutic properties (Shabo & Yagil, 2005). Smaller size of nanobodies of camel milk prevent food allergy and enhance the immune system and inflammations (Shabo & Yagil, 2005).

Lactoperoxidase of camel milk acts against gram-positive and negative strains (Galali & Al-Dmoor, 2019). Camel milk also contains higher amount of zinc that is important in the development and maintenance of normal function of immune system (Habib *et al.*, 2013). Scientists believe in antibodies of camel milk could be effective against cancer cells, HIV, Alzheimer's and hepatitis C (Shabo & Yagil, 2005; Habib *et al.*, 2013). Camel milk has properties of regulatory and immunomodulatory on pancreases  $\beta$  cells. Furthermore, camel milk has anti-malignant, antiplatelet and anti-thrombotic properties in addition to anti-bacterial and anti-viral properties (Elagamy *et al.*, 2009).

Due to presence of insulin/insulin like protein, camel milk exhibits hypoglycemic effects, which can be beneficial in the healing of diabetic cases. Currently, it is proved that camel milk is effective against diabetes complications and heart failures (Shori, 2015). Also currently, it was intensively explored on antimicrobial effects of camel milk lactoferrin (Al-Majali *et al.*, 2007). Furthermore, lactic acid bacteria of camel milk as probiotic are important for the gut health (Yateem *et al.*, 2008). Camel milk has been cured partially autism subjects, food allergies, and crohn's problem (Shabo & Yagil, 2005).

The current review presents therapeutic properties of camel milk according to the scientific documents and researches.

### **Camel milk effects on diabetes**

Diabetes mellitus is one of the most common metabolic disorders that linked with cardiovascular diseases and kidney and liver failures (Wild *et al.*, 2004). Camel milk

contains insulin like proteins, which does not form coagulum in the acidic media of stomach that can be an effective alternative for insulin (Mohamad *et al.*, 2009). In India the incidence risk of diabetes in people who use camel milk regularly, is much lower compared to others who don't use camel milk. Camel milk improves the glycemic control and decrease insulin resistance in diabetes patients (Sboui *et al.*, 2010). It is detected high amount of insulin in camel milk (about 52 unit.litre<sup>-1</sup>), and using of camel milk in diabetes patients causes to reduce blood sugar and required insulin (Agrawal *et al.*, 2003). Camel milk improves obesity, inflammation, wounds, and oxidative stress damages as diabetes complications (Agrawal *et al.*, 2007).

Therefore, camel milk and some its active matters influence pancreatic  $\beta$ -cells and insulin receptors function in the insulin-sensitive tissues, therefore increase insulin secretion (Ayoub *et al.*, 2018).

Camel milk contains insulin like protein and amino acids is enriched with half-cysteine same with insulin, can be absorbed from intestine without destroying in the stomach (Shori, 2015). The reason is presence of fat micelles in camel milk that cover insulin, and transfer to circulatory system in the diabetic patients (Shamsia, 2009). Therefore; camel milk can control diabetes mellitus 1, high cholesterol level, liver and kidney disease, and wound healing. Daily drinking of camel milk may meet about 60% of the insulin in diabetic patients (Shori, 2015). Raw Camel milk has immune-modulatory effects on beta-cells of the pancreas, insulin receptor function and insulin secretion, and reduces insulin amount required

in diabetes 1 patients (Agrawal *et al.*, 2011; Ayoub *et al.*, 2018).

Many recent researches revealed that consuming of whey proteins or peptides of camel milk enhanced healing of wounds in diabetic animals. The whey proteins of camel milk with anti-oxidative activity enhances the of immune cells proliferation and diabetic wounds healing (Ebaid *et al.*, 2015; Aqiba *et al.*, 2019)

The camel milk can normalize renal and liver failures in diabetic patients, that the alanine aminotransferase (ALT) and aspartate aminotransferase (AST) may recover 41 and 48%, respectively (Hamad *et al.*, 2011).

Hypoglycemia effects of camel milk improved kidney and liver function in nephropathy; proteinuria and cardiovascular challenge appear to be major complications in type 1 and 2 diabetes mellitus (Molitch *et al.*, 2004).

Therefore, camel milk is safe in long-term control of glycemic that significantly reduce the required insulin doses in diabetic patients of type 1 (Aqiba *et al.*, 2019). In India, diabetic juvenile treated with camel milk significantly reduced blood sugar (Agrawal *et al.*, 2003).

It is concluded, camel milk can be utilized to cure type 2 diabetes and reduce the required insulin (in some cases the required insulin dose was zero), blood glucose and haemoglobin (Shori, 2015).

Therefore even if camel milk has significant effect in decreasing of blood glucose and required insulin, and improve diabetes problems, but it appears that more scientific studies are needed to confirm the effectiveness of camel milk for the treatment of diabetes.

### Camel milk on autism cases

Autism spectrum disorder (ASD) is a sever malfunctions of neurodevelopment that are accompanied by failures in interactions of communication and social. In addition, high prevalence of gastrointestinal disease and mental retardation happens in autism cases (Bölte & Poustka, 2002).

The increased production of reactive oxygen species and oxidative stress may lead to reduction of injury of brain cell, apoptosis and autism (Russo, 2009). Thus, the control of reactive oxygen production is important for cell function and they should be removed by antioxidants such as enzymes of glutathione peroxidase, catalase and superoxide dismutase (Al-Ayadhi & Elamin, 2013).

Autistic children who using camel milk have had amazing improvements in their behavior (Al-Ayadhi & Elamin, 2013). Camel milk decreases oxidative stress by alteration of antioxidant enzymes and nonenzymatic antioxidant, and improve autistic behaviors. The consumption of camel milk in autistic cases improved motor skills, language and social communication (Panwar *et al.*, 2015).

Researchers reported possibly camel milk cause to immune system recovering, due to the immunoglobulins of camel milk; therefore brain damage would be prevented at early age by consumption of camel milk (Alavi *et al.*, 2017). Wernery & Yagil (2012) reported that the autism cases (children) have a better social condition and improve gut function after the consumption of camel milk.

Camel milk contains high vitamin C, copper, zinc, iron and magnesium as strong antioxidants against free radicals (Kaskous,

2016). Al-Ayadhi & Elamin (2013) reported autism healing by camel milk could contribute to decreasing oxidative stress due to antioxidants such as vitamin C, magnesium and zinc, where are essential for activities of antioxidant enzymes. In autism subjects, due to camel milk containing inflammation-inhibiting and hypoallergenic properties, also smaller size of antibodies can treat gastrointestinal problems and improve some autistic behaviors (Rasheed, 2011).

Lack of  $\beta$ -lactoglobulin, lower content of  $\beta$ -casein, and presence of protective proteins of camel milk enhance immune system and brain development (Galali & Al-Dmoor, 2019).

#### **Anti-microbial effects of camel milk**

Camel immune system is different and stronger from all other mammals. Camel milk IgGs do not have light chains (Gizachew *et al.*, 2014). Due to specificity of camel immunoglobulins with having two heavy chains, they interact with active sites of tissues (Gizachew *et al.*, 2014). As camel milk Igs are found in throughout lactation, combat autoimmune diseases by strengthen the immune system (Muylderman *et al.*, 2001). Immunoglobulins of the camel milk are against tuberculosis bacteria and protect the body from infections of viral (Galali & Al-Dmoor, 2019).

Therefore, camel milk contains various protective proteins and enzymes which have antibacterial and immunological properties (Farah, 1993). These protective proteins of camel milk including lysozymes that participate in immune system, and invade pathogens (Conesa *et al.*, 2008). Immunoglobulins that protect body against infections; Lactoferrin that prevents undesirable microbial growth in

gastrointestinal and alleviate primary immune system (Gizachew *et al.*, 2014). Camel milk apparently contains much more lactoferrin than other ruminant milk. Camel milk lactoferrin is from 95 to 250 ml.dl<sup>-1</sup> which can inhibit the infectious microbe's growth (Morin *et al.*, 1995). Lactoperoxidase can contribute to the defense system and has bactericidal activity on gram negatives. Activity of camel milk lactoperoxidase is about  $2.23 \pm 0.01$  U.ml<sup>-1</sup> of milk (Galali & Al-Dmoor, 2019). Peptidoglycan recognition protein in camel milk by controlling metastasis and stimulating the host's immune response influences breast cancer; the highest amount of this enzyme found in camel milk (Gizachew *et al.*, 2014).

N-acetyl- $\beta$ -glucosaminidase (NAGase) in the camel milk that enhances the activity of antibacterial-antiviral (Hoelzer *et al.*, 1998).

Researchers have concluded that camel milk has beneficial effects on tuberculosis cases that resist to multidrugs (Alwan & Tarhuni, 2000). The camel milk has antimicrobial activity against foodborne pathogens such as *Listeria monocytogenes* and *E. coli* O157:H7. But pasteurization of camel milk had no effect on antimicrobial activity (Ayyash, 2016). Lactoferrin of camel milk has anti-viral activity and inhibits the virus into the cells. The camel milk lactoferrin is very strong and inhibit *Schistosoma mansoni* (Redwan & Tabll, 2007). Camel milk inhibits growth of *E. coli*, *Klebsiella pneumonia*, *Clostridium* species, *Helicobacter pylori*, *Staphylococcus aureus*, and *Candida albicans*. Also it acts against human immunodeficiency virus, infections of hepatitis B and C, cytomegalovirus, and herpes simplex virus-1 (Rasheed, 2017). Therefore according to studies, the most therapeutic

effects of camel milk are due to lactoferrin and Immunoglobulins (Rasheed, 2017).

### **Camel milk effects on food allergies**

Camel milk lacks  $\beta$ -lactoglobulin and a low and different  $\beta$ -casein, which is two powerful allergens in cow milk, makes the camel milk proper children suffering from milk allergies. Camel milk rapidly improved children who suffering severe food allergies (Restani *et al.*, 1999). Also it is new protein source for allergic children to cow's milk (Panwar *et al.*, 2015). But still it needs more researches to be clearer.

Additionally, immunoglobulin's camel milk is same to human milk, which improves allergic reactions to foods. Katz *et al.* (2008) revealed that 25% of allergic cases to cow milk, had allergies to camel milk.

Elagamy *et al.* (2009) found that IgE of children with allergy to cow's milk didn't react to camel milk (Stahl, 2005). Shabo & Yagil (2005) investigated the camel milk effect on eight children with severe food allergies. The children consumed camel milk for two weeks, after 24 hours they have showed fewer symptoms and after four days all the symptoms disappeared. In all subjects, camel milk leads to rapid improvement in digestion of other foods. It is proved that camel milk immunoglobulin's have effective role in reducing allergic symptoms of children.

Eighty % of the children with allergy to foods, improved by using camel milk. These allergic children to cow's milk could safely consume camel milk. Children with severe allergies to food and milk, who no responded to any therapies, could improve after the consumption of camel milk, daily (Shabo & Yagil, 2005).

Additional scientific researchers are needed to confirm the effectiveness of camel milk in healing of food allergies.

### **Camel milk effects on skin health and treating psoriasis**

Camel milk contains  $\alpha$ -hydroxyl acids and is anti-aging which shed skin dead cells. Alpha-hydroxyl acids have important role to eliminate wrinkles and spots and improve dryness (Panwar *et al.*, 2015). These acids are used by cosmetic industries for wrinkles and soften of skin (Babilas *et al.*, 2012). In addition, liposomes of camel milk are beneficial for cosmetic ingredient (Choi *et al.*, 2013). The application of camel milk crème containing 40% raw camel milk showed very good results in psoriasis patients. Itching, skin redness and dryness reduced when 20 patients with psoriasis were treated with 2 x camel milk crème for four weeks, daily (Wernery, 2006).

Presence of high vitamin C in the camel milk as strong antioxidant has protective activity on skin tissue against free radicals and heals skin issues; wrinkles and dryness. Vitamin C has a key important in collagen synthesis, the growth of cells and blood vessels and strengthens skin firmness (Jilo & Tegegne, 2016). Furthermore, following to camel milk consumption, some bioactive peptides that produced from digestion of camel milk protein are act as natural antioxidants and ACE inhibitors (Salami *et al.*, 2011; Yagil, 2017).

### **Camel milk against Hepatitis C and B**

It is reported that the high lactoferrin of camel milk is as a primary drug against HCV infection and leads to complete inhibition of virus entry (Redwan & Tabll, 2007). In addition to lactoferrin, camel milk IgG can recognize

peptides of Hepatitis C virus in comparison with human IgG (El-Fakharany *et al.*, 2012). In addition, camel milk can enhance the cellular immune responses, inhibits the replication of virus DNA and recovers chronic hepatitis B patients (Saltanat *et al.*, 2009).

Redwan & Tabll (2007) observed 88% improvement in enzymes of alanine and aspartate aminotransferase in eighteen HCV patients who were fed with camel milk. About 50% of the patients noticeably showed improvement in fatigue. El-Fakharany *et al.* (2013) demonstrated that the camel milk lactoferrin effectively stop HCV entry and replication in infected HepG2 cells was more than lactoferrin of human, bovine, and sheep milk.

The protective and therapeutic effects of camel milk on liver induced injury of rats by ethanol explored by Darwish *et al.* (2012). Using of camel milk normalize liver enzymes, improved liver function, reduced serum triglycerides, hepatic malondealdehyde and TNF- $\alpha$  and apoptosis, as well as enhancement of total antioxidant capacity and the antioxidant defense system (Darwish *et al.*, 2012).

The camel milk consumption for eight weeks recovered liver function, reduced hepatic fat and inflammatory infiltration and increased the activity of glutathione and catalase enzymes (Korish & Arafah, 2013).

According to research, camel's milk was more effective than mare's milk in improving and normalizing of patient's status with chronic active hepatitis. It is proved that camel milk lactoferrin is stronger anti-viral than human and bovine milk lactoferrins (Redwan & Tabll, 2007).

Camel milk contains casein that begins the apoptosis of HCV cells (Almahdy *et al.*, 2011). High vitamin C of camel milk improves liver function (Gul *et al.*, 2015). Also the antibodies in camel milk selectively control virus systems. Therefore, camel milk antibodies are about tenth of human antibodies size that makes more affinity to penetrate to the targeted antigens (Muyldermans *et al.*, 2001).

### **Camel milk as anti-cancer factor or nutrient**

Studies have proven that camel milk stop cancer cells through the activation of apoptotic pathways (Galali & Al-Dmoor, 2019). High amounts of camel milk immunoglobulins, lactoferrins and iron - binding glycoprotein are antitumor matters, due to increasing RNA synthesis and the inhibition of protein kinases. Also camel milk lactoperoxidase possess anti-tumor activity. Peptidoglycan recognition protein in camel milk combat breast cancer by take over metastasis (Galali & Al-Dmoor, 2019).

Camel milk markedly inhibited the cancer cells proliferation by 50% by activation of caspase-3 mRNA (Korashy *et al.*, 2012), and exerts antioxidant with activity of DNA damage inhibitory (Habib *et al.*, 2013). According to study of Gader & Alhaider (2016); camel milk can remove cancer cells of hepatic, colon, lung, glioma cells and leukemia The active antibodies of camel milk are able to destroy cells of tumor (Levy *et al.*, 2013). Additionally, camel milk have thrombolytic activity which inhibits fibrin formation, consequently inhibit the of tumor cells growth (Jilo & Tegegne, 2016).

Also camel milk lactoferrin inhibit the *in vitro* proliferation of colon cancer cells and the DNA damage (Habib *et al.*, 2013).

Anti-tumor properties of camel milk are due to strong antimicrobial and anti-oxidative activities that reduce liver inflammation. The effects of antigenotoxic and anticytotoxic of camel milk inhibit micronucleated polychromatic erythrocytes (Salwa & Lina, 2010). Although, camel milk lactoferrin, reduced cancer growth by 56%, but further researches is needed to confirm camel milk lactoferrin on stopping cancer (Habib *et al.*, 2013).

### **Camel milk as anti-inflammatory and anti-arthritis agent**

Higher amount of camel milk lactoferrin has that removes free iron from joints of arthritic patients, therefore improves arthritic (Panwar *et al.*, 2015). Camel milk lactoferrin activity has properties of cartilage protective, anti-arthritic and anti-inflammatory (Rasheed, 2017).

Camel milk has anti-inflammatory effects against infectious diseases. Furthermore, high level vitamin C, zinc and magnesium are very essential to decrease oxidative stress (Al-Wabel *et al.*, 2012).

### **Camel milk effects on gastrointestinal failures**

#### **Diarrhea**

High concentration of anti-inflammatory proteins of camel milk have proper effects on the stomach and intestinal issues. The high content of unsaturated fatty acids and vitamins of camel milk improve carbohydrates metabolism. Moreover, the presence of Angiotensin I-converting enzyme in fermented camel milk improves the digestibility of the camel milk proteins (Alhaj *et al.*, 2006; Quan *et al.*, 2008). Recent reports on the beneficial effects of camel milk on the digestive system

health confirmed that camel milk has properties of anti-diarrhea in the children (Yagil, 2013). Camel milk is rich in anti-rotavirus antibodies, may be used to treat diarrhea by rotavirus contamination in children (Yagil, 2013).

### **Lactose intolerance**

Studies on 25 patients with lactose intolerance that consumed camel milk have showed good results that camel milk is a suitable option for the lactose intolerant people (Cardoso *et al.*, 2010). Lactose-intolerant patients easily digest camel milk (Mullaicharam, 2014). The reason is high concentration L-Lactate in camel milk in compared to cow milk that is rich in D-Lactate (Baubekova *et al.*, 2015).

### **Camel milk effects on blood cholesterol and cardiovascular diseases**

The fermented camel milk has hypocholesterolemic effects in rats, that mechanism is still unrecognized well (Elayan *et al.*, 2008). But maybe, the interaction between bioactive peptides of camel milk and cholesterol decrease cholesterol (Li & Papadopoulos, 1998). According to other researches, the presence of orotic acid produced from the nucleic acid metabolism is responsible for the lowering of cholesterol amount in rats and humans consumed camel milk (Kaskos, 2016).

The administration of camel milk for five weeks showed a significant decrease in the total cholesterol from 6.17 to 4.35 m mol. l<sup>-1</sup> (Shori, 2015). Al-Numair (2010) concluded that the administration of camel milk for 45 days significantly decreased hyperlipidemia; total cholesterol, triacylglycerol's, free fatty acid, LDL, and VLDL in plasma, liver, heart and kidney towards normal levels. Also after

consumption of camel milk, the content of HDL significantly improved. Other researcher's recently reported the hypocholesterolemic effect of fermented camel milk or Gariss (Ali *et al.*, 2013). After using of camel milk for 6 months, the amounts of LDL and triacylglycerol's reduced in type 1 diabetic cases (Agrawal *et al.*, 2009).

### **Camel milk effects on tuberculosis and crohn patients**

There is a significant improvement of symptoms of tuberculosis through consumption of camel milk by drug-resistant patients. By administering of camel milk by 1 litre per day, consequently these patients didn't show cough, sputum and chest pain (Wernery & Yagil, 2012). In addition, immunoglobulins of camel milk restore the immune system and can be effective on Crohn's disease (Kaskous *et al.*, 2016).

### **The camel milk effects on toxic metals**

Camel milk high content of antioxidant vitamins, magnesium, zinc and possible chelating effects on cadmium; reduced free radicals and oxidative stress in the red blood cells and improved toxic effects of cadmium (Dallak, 2009). Also, using of camel milk for 30 days improved toxic effects of aluminium by high increase in total erythrocytes, haemoglobin and haematocrit (Al-Hashem, 2009).

Treatment of lead acetate poisoned rats with camel milk recovered liver enzymes function (Al-Humaid *et al.*, 2010). According to Al-Asmari *et al.* (2014), the inhibiting effect of camel milk on oxidative stress and inflammation protect the structural integrity of hepatocyte membranes and regenerate destroyed hepatocytes.

The consumption of camel milk after irradiation could restore the liver function and content of alanine and aspartate aminotransferase and glutathione in rats (Mohamed & Ali, 2008).

### **Conclusions**

Due to camel milk containing vitamin C and protective proteins such as lactoferrin, immunoglobulins and lactoperoxidase, it has an important role in the healing of human serious diseases. Camel milk as raw, fresh and free of pathogens is effective on diabetes, food allergies, cancer, hepatitis, autism and enhances the immune system. However, about the medicinal effects of camel milk, still it needs to do more studies to prove these properties.

### **Conflicts of interest**

The authors declare that they have no conflict of interests.

### **Ethical approval**

All applicable institutional, national and international guidelines for the care and use of animals were followed.

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## حليب الابل كعلاج مذهب للمشكلات الصحية: مقالة مراجعيه

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**المستخلص:** يعد حليب الإبل ذو فوائد فريدة لصحة الإنسان. وان البروتينات هي المكون الرئيسي لحليب الابل الذي تعطيه مميزات فريدة وتؤثر بشكل فعال على قيمته الغذائية. بسبب نقص البيتا لاکتوکلوبيولين في حليب الإبل ، لذا قد يكون بديل مناسب للحليب البشري. ان حليب الإبل غني بفيتامين C والمنغنيز والحديد. كما يحتوي على كمية كبيرة من الأحماض الدهنية غير المشبعة و الكلوبولينات المناعية والبروتينات المشابهة للأنسولين والإنزيمات الواقية مثل اللاكتوفيرين وللايسوزايم. يُعد اللاكتوفيرين ذو تأثيرات أو خواص مضادة للبكتيريا والفيروسات ومضادة للالتهابات. اثبتت الدراسات أن حليب الإبل له تأثيرات مفيدة في اضطرابات المعدة والأمعاء وحساسية الطعام وداء السكري والسرطان والتوحد والتهاب الكبد الفيروسي. يحتوي حليب الإبل على البروتينات المشابهة للأنسولين الذي قد تساعد في شفاء مرض السكري من النوع 1 و 2 وداء السكري الحلمي. بالإضافة الى ان حليب الابل يحتوي على كلوبيولين مناعي صغير الحجم الذي يقوي جهاز المناعة. إن حليب الإبل يقلل من كمية الكوليسترول في الدم ويقي من مرض الصدفية ويساهم في شفاء الالتهابات ومرض السل. لذا قد يكون حليب الإبل فعالا كمعجزة فريدة في العديد من المشكلات الصحية البشرية وخاصة القلب والأوعية الدموية. لذلك فهو ليس طعاماً فقط وانما علاجاً مدهشاً للمشكلات الصحية البشرية.

الكلمات المفتاحية: حليب الابل، الصحة،لاكتوفيرين، الفوائد الطبية.