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Review Article

A Review on Camel Milk and Its Medicinal Properties

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DOI: 10.53389/RJAHS.2022010102

A B S T R A C T

In Quran, camel has been labelled as a miracle of Allah. According to Hadith, camel milk is recommended for the treatment of several diseases i.e. autoimmune disorders. Food and Agriculture Organization showed the total population of camel is about 25.89 million, worldwide. In this population, 11% are 2-humped, 60% dromedary camel and 89% are 1-humped camel. Camel milk has unique properties than other specie's milk i.e. cow, goat, sheep, buffalo and human milk with sweet, bitter and sometimes salty taste. It is used as a food for children and elderly peoples. It consists of low-sugar, low-cholesterol, protective protein i.e. lactoperoxidase, immunoglobulin and lactoferrin, high minerals i.e. magnesium, calcium, phosphorus, sodium and potassium and high in vitamins i.e. B, C, A, E and D. Due to low level of β-lactoglobulin, it is used as an alternative for children and peoples who have cow milk intolerance. Now a day, it is used to treat many diseases due to its anti-oxidant and anti-inflammatory properties. Medically, it can reduce the risk of autism and cancer. It has beneficial effects for many infectious diseases such as hepatitis, tuberculosis, diarrhea, bacterial and viral infections and different types of allergies. It is helpful in strengthening immune system and fight against autoimmune diseases i.e. Crohn's disease, psoriasis, eczema, arthritis. Due to naturally present insulin, it can improve hyperglycemia and decease glycosylated hemoglobin (HbA1C), in that way it can lower the requirement of insulin and used to treat diabetes. As whole camel milk is an amazing remedy for the treatment of various health issues. This review focused on the nutritional and medicinal properties of camel milk.

Keywords: Camal Milk, Medicinal Properties, Anti-oxidant, Anti-inflammatory, Autoimmune diseases, Immune system, Hyperglycemia

Introduction

Food and Agriculture Organization (FAO) indicated the total camel population is about 25.89 million, worldwide. In this population, 11% are 2-humped (*Camelusbactrians*), 60% dromedary camel and 89% are 1-humped camel (*Camelusdromedarius*). *Camelusbactrian* found in the Asia (cold dessert) and dromedary camels found in the North East African *i.e.* Sudan, Kenya, Ethiopia and Somalia. After Sudan and Somalia, Ethiopia rank 3rd by the number of camels, worldwide.[1] In Quran camel has been labelled as a miracle of Allah. According to Hadith, camel milk recommended for the treatment of several diseases *i.e.* autoimmune disorders. In Quran (surah al ghashiya, Verse 17) Allah says, "In the name of Allah, the beneficent, the merciful will they regard the camels, how they are created" A Hadith related to Abu Qilaba (Sahih Bukhari, Ablutions (Wudu'), Volume 1, Book 4, Number 234):

"Anas said, "People from the tribe of 'Urania' or 'Ukl', came to Medina. The climate of Medina had adverse effects on them. So, the Prophet Muhammad (PBUH) advised them to go and to drink camel milk and urine (as a medicine). They followed the instructions given by Prophet (PBUH) and had a quick recovery." Camel milk used as a food for children and elderly peoples. It is rich in insulin, lactoferrin, minerals such as magnesium, iodine, potassium, sodium, protein and vitamins such as Vitamin B2, B12, and C. It contains low-fat, cholesterol and lactose.

Recently, camel milk used as a therapeutic purpose. It shows to strengthen immunity and also used to treat various diseases *i.e.* diarrhea, cow-milk allergy, diabetes, hepatitis, cancer, psoriasis, malnutrition and fight against bacterial and viral infections. [2]

Composition

Camel milk is white liquid with salt like flavor. The thickness of camel milk differs from 1.026-1.035 and pH 6.2-6.5. In general, camel milk contain 3.4% protein, 4.4% lactose, ash 0.79%, water 87%, fat 3.5%.[3] Water is the important component of camel milk an increase during dry condition. 86% water present in camel milk and in dehydration is increase to 91%. It is helpful to treat dehydration in humans. [4] Camel milk contain about of almost 2.15%–4.90% total protein. The protein composition of camel milk is moderately unique. The whey protein is high in camel milk and casein protein is similar as cow milk. Major protein is β-casein (αS1-casein about 65% and κ-casein 3.47%). It contains 20-25% of total proteins. Total 1.63%–2.76% of casein present in camel milk. Main constituent o casein is κ-casein is about 3.5% and β-casein and is about 65% (αs1-casein 21%, αs2-casein 9.5%), of total casein. Camel milk and human milk are similar as it contains higher concentration of β-casein then α-casein. Absence of β-lactoglobulin and presence of β-casein is responsible to control allergies such as cow milk allergy.[5] Whey is the second most important protein in camel milk. It ranges is about 0.80 g per gram (20-25% percent of total protein). Lactoferrin, lysozyme, immunoglobulin, lactoperoxidase, peptidoglycan, lactoalbumin, serum albumin and peptidoglycan recognition proteins are main constituent of camel milk.[6] Three type of immunoglobulin present in camel milk that is 1gG, 1gA and 1gM.[7] Camel milk contain 1.2-6.4% of fats. The average cholesterol is about 34.5mg per 100g [8]. Depending on factors like nutrition level, lactation stage, breed, season, etc., camel milk has a fat content that ranges from 1.2 to 5.4% with an average of 3.2%(Patel et al., 2022). Camel milk consist of various fatty acids *i.e.* palmitic, myristoleic, caproic, palmitoleic, stearic, leoleic, arachidic, butyric, caprylic, capric and myristic acid. These fatty acid helps to fight against foreign particles or antigens. Camel milk contain higher concentration of linoleic acid and PUSFA, which are important for growth and development (table 1).[9]

Table 1. Camel milk composition comparison with different animals' milk [1]

	Lactose (%)	Protein (%)	Fats (%)	Ash (%)	Water (%)
Camel Milk	3.3	3.0-3.9	2.9-5.4	0.6-0.9	86-88
Human Milk	6.8-7.0	1.1-1.3	3.3-4.7	0.2-0.3	88-89
Cow Milk	4.8-4.9	3.2-3.8	3.7-4.4	0.7-0.8	85-87
Sheep Milk	4.3-4.8	5.6-6.7	6.9-8.6	0.9-0.10	79-82
Buffalo Milk	4.5-5.0	3.3-3.6	7.0-11.5	0.8-0.9	82-84
Goat Milk	3.6-4.2	2.9-3.7	4.0-4.5	0.8-0.9	87-88

Vitamins and Minerals

Mineral content is about 0.82-0.85%. Important minerals are magnesium, calcium, phosphorus, sodium and potassium. Camel milk is a good source of chloride. Some trace minerals like iron, zinc, and copper also present. Total 100g of camel milk gives potassium (44-156 mg), sodium (59 mg), phosphorus (87.4 mg), calcium (144-166 mg), magnesium (10.5-12.3 mg), zinc (530-590 mg), manganese (80 mg), copper (140 mg), chloride (0.20-12.3 mg) and iron (230-290 mg).[8] Iron is the most important mineral and have important role in DNA synthesis, oxygen transport and electron transport mechanism. Other minerals such as Zn, Mn and Mg require for various enzymes activation and act as a cofactor.[10] Several essential vitamins also present in camel milk *i.e.* vitamin B, C, A, E and D. Camel milk contain highest amount of vitamin C is about 34.16 mg/L.[11] B vitamins especially thiamin act as a cofactor in the amino acids and carbohydrates metabolism. Ranges for riboflavin is about 0.43-0.78 mg/L. Niacin content is high (0.77 mg per 100 ml). Thiamin and niacin both involved in the electron transport chain. Total 100 mL camel milk also contain 0.36 mg pantothenic acid, 87 µg folic acid, 85 µg cyanocobalamin and 0.55 mg pyridoxine. B6 is important for glycogen and protein metabolism and helps to store energy in muscles. Vitamin B12 is essential for the red blood cells development. Vitamin E content of both camel and cow milk is almost equal. Vitamin A concentration is lower as about 0.1 mg/L. Both act as an antioxidant and protect from the oxidative damage (table 2).[12]

1.3. Lactose

Lactose present in camel milk is about 2.40% to 5.80%. Findings shows that lactose content varies according to hydration status and season.[13]

1.4 Enzymes

Camel milk also contain enzymes *i.e.* AST-aspartate, ALT-alanine aminotransferase, ALP-alkaline phosphate, ACP-acid phosphate, LDH-lactate and γ- GT-gamma glutamyl transferase (table 3).[15]

Table 3. Enzymatic Composition of Camal Milk [16]

Enzyme	Concentration (IU/L)
Lactate dehydrogenase	132–168
Gamma glutamyl transferase	254–296
Aspartate aminotransferase	7.98–9.21
Acid phosphatase	2.74–3.08
Alkaline phosphatase	16.04–24.93
Catalase	0.083–0.193mol/min/g of protein
Alanine transferase	9.49–11

1.5 Bioactive proteins

Protective protein like peptidoglycan recognition protein, N-acetyl-β-glucosaminidase (NAGase), immunoglobulin, lactoferrin, enzymes, lactoperoxidas present in camel milk is responsible for its antibacterial, immunological properties and antiviral.

Lysozymes

Lysozyme protect from gram-positive bacteria because it a part of innate immunity. It works with the immune system and damage pathogens structures. Lysozymes present in camel milk break the structure of microorganisms especially Salmonella typhimurium (figure 1).[16]

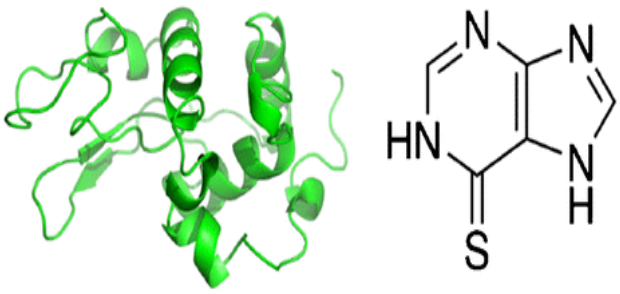

Figure 1. Lysozymes present in Camal Milk [17]

Immunoglobulin

Immunoglobulin are antibodies helps to strong immunity and fight against several antigens. Antibodies present in animals and human blood serum. Different types of antibodies present in humans or animal blood serum *i.e.* immunoglobulin M (IgM), immunoglobulin G (IgG), immunoglobulin A (IgA), immunoglobulin D (IgD) and immunoglobulin E (IgE). Immunoglobulin concentration in milk differ according to the animal health, lactation period and animal species. IgG level is higher in camel milk (1.64 md.mL-1) then other species (cow, buffalo, sheep, human and goat milk).

Lactoferrin

Lactoferrin is a glycoprotein, a class of lactoferrin (second name lactotransferrin). It has a unique quality that it binds with the two metal cations (preferably Fe 3+) to the binding sites that are structurally closely related. Camel milk have higher content of lacoferrin (0.22 mg.mL-1) as compare to other species such as cow, goat, sheep and buffalo. Camel milk colostrum contain high lactoferrin (5.1 mg.mL-1). Lactoferrin content decrease up to 0.34 mg.mL-1 after one month of parturition. Findings shows that lactoferrin level was maximum at first day of lactation (colostrum) and then decrease with milking (figure 2).[18]

Table 2: Nutritional Composition of Camal Milk [14]

Macro Nutrients		Micro Nutrients	
Energy (kcal)	759	Vitamins	
Proteins (g)	34.6	Thiamine (B1)	0.5
Amino Acids		Riboflavin (B2)	0.7
Valine	1.92	Niacin	5.2
Tryptophan	0.72	Vitamin C	46
Threonine	2.12	**Minerals**	
Phenylalanine	1.48	Phosphorus	760
Methionine	1.04	Potassium	1790
Lysine	2.64	Zinc	1.9
Isoleucine	1.96	Iron	2.1
Leucine	3.6	Sodium	580
Arginine	2.0	Calcium	1090
Histidine	1.16	Magnesium	140

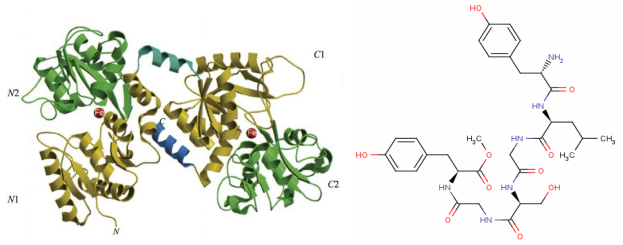

Figure 2: Lactoferrin present in Camal Milk [19]

1.5.3. Lactoperoxidase

It is found in the saliva, milk and tears. It's also improve immunity and defense system against many different bactericide *i.e. salmonella, pseudomonas* and *E.coli*. Due to presence of lacto peroxidase, camel milk has anti-tumor properties and enhance growth activity (figure 4).

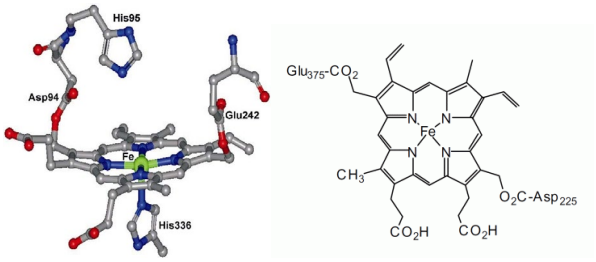

Figure 3 : Lactoperoxidase present in Camal Milk[20]

1.5.4. Peptidoglycan Recognition Protein:

This protein has highest concentration in camel milk. Is stimulate antimicrobial activity and immune response (figure 5).

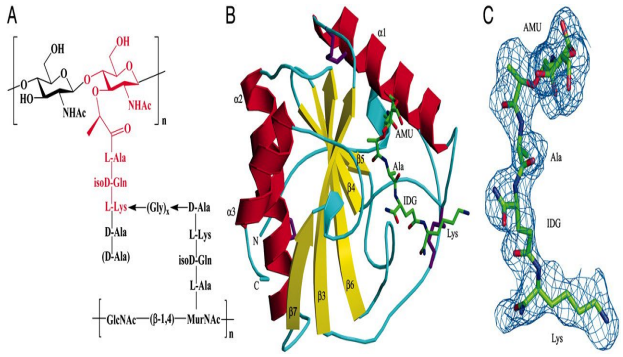

Figure 4: Peptidoglycan Recognition Protein in Camal Milk[21]

1.5.5. N-Acetyl-β Glucosaminidase

Camel milk is rich in NGAase which is responsible for its antiviral and antibacterial property. Its activity is similar to human milk.

2. Shelf life of camel milk

Shelf life of unprocessed camel milk is about 5 days at 7°C temperature pasteurized milk have 22 days at temperature of 7°C. Under frozen condition shelf life for fresh camel milk is about 1year .[9]

3. Medicinal Uses of Camel Milk:

The medicinal uses of camal milk has been described in figure 6.

3.1. Anti-inflammatory anti-oxidant properties

Camel milk contain lactoferrin which have immune modulatory functions. Its helps in the activation and maturation of lymphocyte, macrophages and neutrophils. Findings shows that lactoferrin present in the camel milk is responsible for the anti-cancer, anti-oxidant, anti-inflammatory and anti-arthritic effect. Lactoferrin inhibit the activity of IL-1β-induced activation through inhibiting the activity of nuclear kappa B signaling. Moreover, it also blocks the activity of IL-1β-induced cyclooxygenase -2 expression and prostaglandin E2. Through this mechanism it protects the cartilage and seem helpful in chondroprotective mechanism. Higher content of antibodies in camel milk helps to fight against autoimmune disorders *i.e.* Alzheimer's disease and multiple sclerosis. A previous study investigated that camel's milk as a potential protein substrate for producing bioactive protein hydrolysates with antioxidant activities. When camel's milk casein hydrolysates were digested using gastrointestinal enzymes, it's antioxidant activity increased. The techniques for assessing antioxidant capacity may be divided into two categories based on chemical processes. The first category comprises methods based on electron transfer (ET), such as 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and ferric ion reducing antioxidant power (FRAP) test. The second category comprises procedures based on hydrogen atom transfer (HAT), such as total radical trapping antioxidant parameter (TRAP) and oxygen radical absorbance capacity (ORAC) assays.[22]

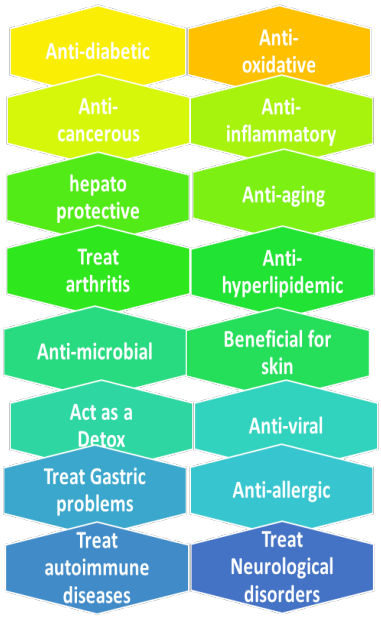

Figure 5: medicinal uses of Camal Milk

3.2. Anti-Diabetic properties:

Due to pancreatic dysfunction, there is no enough production of insulin. In different studies, camel milk shows effected results in diabetic treatment. According to the studies, insulin present in camel milk easily absorb in circulation the other sources of insulin. Insulin present in camel milk easily passed through stomach and enter into circulation due to encapsulated in lipids vesicles.[23] Peptides presents in camel milk is similar to insulin peptide and rich in cysteine (insulin like peptide). Different findings show that camel milk inhibits elevation in gut incretin hormones (GIP and GLP-1) in diabetic animals.[24] Previous studies show that our body mechanisms (cellular and molecular response) and camel milk works together and decrease blood sugar level. Findings shows that camel milk activate human insulin receptor (hIR) and helps in the regulation of glucose metabolism. A recent study investigates the anti-diabetic of camel milk in the diabetic rat model. The results showed that camel milk have highest level of vitamins (C, E, A and B_2) which protect body from tissue damage by poisonous ingredients. On the other hand, camel milk has significantly reduced blood glucose, HbA1c ($p < 0.001$) compared to that in the diabetic control group.[25]

3.3. Anti-bacterial and antiviral properties

Essential enzymes like lactoperoxidase and lactofferin and defensive protein like caseins present in camel milk fight against bacterial infection and stronge immunity.[4] It contains N-acetyl-§-glucosaminidase (NAGase) that improves antiviral-antibacterial activity. It fights and protect from foodborne micro-organisms *i.e.* E. coli, Listeria monocytogenes. Lactoferrin present in camel milk inhibit the Schistosoma mansoni activity and growth of *Staphyloccous aureus, E.coli, Helicobactor pylori, Candida albicans* and *Clostridium* species [26]. Its fight against hepatitis C and B cytomegalovirus, herpes simplex virus and human immunodeficiency virus. Camel milk lactoferrin has antiviral action and prevents viruses from entering cells. The virucidal activity of lactoferrin is due to its cationic nature and alpha-helical structure. This activity's method of action is the neutralization of viral particles and the suppression of their reproduction. It also influences the activation and development of immune cells such macrophages, lymphocytes and neutrophils .[27]

3.4. Anti-allergic Properties and Lactose Intolerance

Camel milk is the best remedy for children allergy *i.e.* cow milk allergy. Structure of camel milk protein (β-casein) is dissimilar from protein present in cow milk. Human antibodies monoclonal and IgE failed to recognize the protein present in camel milk due to hereditary difference. In children having severe allergy, it shows positive effect.[28]

Research conducted by Ehlayel et al. 2011 on children (35children of age 4-126months), having food allergy treated with camel milk. After investigation and test (Skin prick test), it shows positive result. They conclude that camel is safe remedy as an alternative.[29] 0.6 to 0.2% preschoolers, 0.3% older children and teens and less than 0.5% adults suffer from lactose intolerance.[30]

Camel milk use as an alternative for lactose intolerance children due to low amount of lactose and small molecules easily digestible and metabolize by human digestive system without any complications [31]. Due to easily digestible, lactose eliminates from digestive tract more rapidly and prevent from gastrointestinal disorders. Whey proteins of camel are rich in serum albumin, lactoferrin, α-lactalbumin, lysozyme, α-lactalbumin and immunoglobulins. Camel milk will protect against Crohn's, a type of inflammatory bowel disease. Thus, camel milk

composition with high amount of bioactive proteins and no or lower content of allergic proteins.[32]

3.5. Treatment for Neurological disorder and Autism

Autism is a severe neurological disorder in which brain development impaired at the age of 3 years. Due to impaired development the social and communication skill effected. Due to high mineral contents (zinc, copper, sodium, potassium, magnesium, vitamin C and iron), camel milk act as an antioxidant. Findings shows that after camel milk consumption glutathione level increase, due to antioxidants. Magnesium present in camel milk enhance vitamin C and E absorption and reduce oxidative stress. Zinc increase glutathione level, superoxide dismutase, catalase level and glutathione peroxidase. High level of antioxidants (Mg, Zn and Vitamin E) can decrease free radical stress and enhance enzyme and glutathione production in autistic patients [33].

Recent studies shows that enhance neurological activities *i.e.* communication skills, social awareness, social cognition, ability of speech and language.[34]

Another neurological disorder epilepsy characterized by rhythmic, unpredictable and recurrent electrical firing of brain nerves called seizures. Recent studies showed its positive effect against seizures, fits. Anticonvulsant effect due to the glycinergic and GABAergic stimulatory activities. It also has antioxidant affect that's improve epileptic symptoms. Studies confirmed that camel milk has shown positive effect results against autism. For instance, its consumption can reduce symptoms of autism. Reports also show that camel milk decreases oxidative stress by altering non-enzymatic and enzymatic antioxidant molecules, which improve autism in children as shown by the improved Childhood Autism Rating Scale (CARS).[35]

3.6. Treatment for Gastrointestinal Problems

Camel milk important for healthy digestive system. It has anti-diarrheal property. Researches shows that children with the 20 bouts of diarrhea per day were treated with camel milk and the patients recovered. Due to high amount of anti-rotavirus antibodies, it also cured diarrhea caused by food contamination with rotavirus [36]. Fermented camel milk contain angiotensin I-converting enzyme (ACE), which helps in milk protein digestion and prevent from gastrointestinal problems.[37]

3.7. Beneficial in Hepatic problems

Evidence shows that camel milk is helpful in the treatment of hepatitis C and B. Fat present in camel milk soothes the liver cells. It reliefs from symptoms in chronic liver patients. Higher content of vitamin C enhance liver functions.[38] It has protective effect on Paracetamol-induced hepatotoxicity. In rats study, evidence shows that it prevent from Paracetamol-induced elevation in serum glutamate oxaloacetate, serum glutamate pyruvate transaminase and alkaline phosphatase levels.[39] Due to its antioxidant activity (high amount of vitamin C, A, E), it protect liver from damage. Due to antioxidant and antimicrobial property, it can prevent from hepatic cell degradation and responsible for healthy liver function. Camel milk, reduce the oxidative stress induced by the fipronil and lead. The analysis of camel milk showed that it containd vitamins (C, E & A) and minerals (Zn, Na, P, Fe, Ca, K and Mg) in high amount. These compounds are potent anti - oxidants that have strong free radical scavenging abilities. Due to these properties camel milk protect against hepatitis, hepatotoxicity, liver injury and liver cirrhosis.[40]

3.8. Treatment for Crohn's Disease

Crohn's disease is an autoimmune disorder in which inflammation of gut and digestive system cause by Mycobacterium avium. Studies reported that camel milk effected in autoimmune diseases and have a quick recovery. Immunoglobulin present in camel milk strengthen immunity and can be improved the symptoms. Camel milk "protective proteins" permit into the intestinal tissue, terminating the *Mycobacterium avium paratuberculosis* and assimilating the immune system. As camel milk has been used to treat bacterial infection and positive effect on the healing of crohn's diseases that caused by bacteria belongs to the family of tuberculosis.[41]

3.9. Anti-Cancer Properties

Studies reported that camel milk contain α-cLA which binds with OA and form a complex compound called as CAMLET (camel α-lactalbumin made lethal to tumor cells). CAMLET have highly anticancer properties.[42] Various studies have shown that cow milk contains

sufficient concentration of LF (iron-binding protein) and immunoglobulins, which play an important role to prevent the cancer development and have anti-cancer effect (Asif et. al.,2022)

Evidence shows that it has ability to inhibit the cancer-activating genes (Cyp1A1). In that way it can protect from cancer.[43] Animal based studies showed that camel milk also have tumor suppressing properties due to present of whey protein in it.[44] It contain number of antibodies which binds with tumors and kill it without damaging normal body cells.[45]

3.10. Treatment of arthritis

Lactoferrin an iron chelating protein present in higher amount in camel milk. This protein have ability of removing free iron from the joints of arthritic patients thereby improves arthritic.[9]

3.11. Treatment for asthma

Asthma is an inflammatory disease (inflammation of airways). Reactive oxidative species is responsible for the inflammation. If untreated, I may be severe and can be life threatening.

Anti-oxidant, immunomodulatory and anti-oxidant activity of camel milk and its proteins in reduction of the inflammatory cytokines such as IL-6, IL-17, IL-1B, TNF-a, vascular endothelial growth factor, and TGF-β1 in various inflammatory diseases in human and animal species. Camel milk is a natural remedy to treat asthma due to its beneficial properties.[46]

3.12. Anti-aging Properties

Camel milk have anti-aging property. Evidence showed that when camel milk consumed and digested by body, it produces peptides which acts as ACE inhibitor and natural antioxidant. Camel milk contain high level of vitamin C which protect collagen and act as an anti-aging agent. Vitamin C is an anti-oxidant and protect from tissue damage. It also helps in strengthen immunity.[47] Alpha-hydroxyl acid present in milk is responsible for anti-aging property. It helps to shed the outer dead skin cells and helps to grip the skin cells strongly. It helps to regenerate new, more elastic cells. It's also help to remove wrinkles and helps get rid from dryness. Liposomes in milk is used in cosmetics and also enhance anti-aging activity.[1]

3.13. Act as a Detox

Antioxidant such as vitamins, magnesium, zinc and chelating effect on cadmium, decrease oxidative stress and free radicals in the body and decrease poisonous effect of cadmium. Evidence shows that 30 days treatment with camel milk improved the aluminum toxicity by increasing hemoglobin, hematocrit and erythrocytes. Rats studies shows that milk can treat lead toxicity by improving the liver enzyme activity.[48] CCl4 (carbon tetrachloride) is a cause of cirrhosis, hepatocarcinoma and fibrosis due to free radicals and increase oxidative stress due to its toxicity. Camel milk show positive effect and prevent from liver damage.[49] Fermented milk protect against lead toxicity due to lactic acid bacteria. Lead can cause serious health issues such as anemia, saturnism and cancer. Product of fermented camel milk named as 'shubat' could decrease the lead toxicity.[50]

3.14. Beneficial for tuberculosis patients:

A study concluded that consumption of camel milk may help to relief symptoms in tuberculosis patients. Observation showed that improvement in cough and chest pain.[51]

3.15. Treatment for Anemia:

A scientific study result suggested that when anemic people treated with camel milk and folic acid it helps to increase in hemoglobin level (Hb), white blood cells (WBCs), Iron (F) and PCV. Findings shows that camel milk can reduce the risk of sickle cell anemia.[52]

3.16. Treatment for Hypercholesterolemia:

Evidences shows the hypercholesterolemic effect of camel milk in rats. Observations shows that it orotic acid produced from the metabolism of nucleic acid helps to reduce cholesterol in human and rats.[41] Another study concluded that camel milk reduce the level of LDL, VLDL, triglycerides, free fatty acids and total cholesterol in plasma towards normal levels. The level of HDL also improved after its consumption.[53]

3.17. Camel milk as a Skin Care remedy:

Alpha-hydroxyl acids present in camel milk has anti-aging property and also helps to remove dead skin cells. This component is important to remove wrinkles and recover dry skin condition [9]. This acid also used in cosmetic

industries for softening of skin and wrinkles [54]. Liposomes in camel milk are useful for cosmetic products [55]. Due to present of antioxidants especially vitamin C, it also has protective effect against free radicals and helps in healing process such as wrinkles and dry skin conditions. Vitamin C is also important for synthesis of collagen fibers, strengthening skin firmness and the growth of cells and blood vessels. Vitamin such as B, C, carotene and minerals *i.e.* iron are important for healthy skin. Milk have moisturizing property which provide smoothing effect on skin. In addition, it may help to treat many skin disorders *i.e.* acne, dermatitis, eczema and psoriasis. [1]

Conclusion

It is concluded that camel milk has significant role in the healing of serious health issues. It is a natural source to strengthen immune system. Natural antioxidant and anti-inflammatory properties, make it able to cure many chronic and infectious disease *i.e.* autism, cancer, crohn's disease, gastrointestinal problems, hepatitis, diabetes, skin diseases, anemia and cardiac problems.

References

1. Kula JT, Tegegne D. Chemical composition and medicinal values of camel milk. Int J Res Stud Biosci, (2016); 4(4): 13-25. https://doi.org/10.20431/2349-0365.0404002
2. Fufa DD, Haile A. Quality and Therapeutic aspect of camel milk: A review paper. Journal of Current Research in Food Science, (2020); 1(1): 37-45.
3. Sumaira AMS, Solangi GA, Anwar I, Kalwar Q. Composition and Beneficial Impact of Camel Milk on Human Health. Punjab University Journal of Zoology, (2020); 35(2): 179-189. https://doi.org/10.17582/journal.pujz/2020.35.2.179.189
4. Kula J. Medicinal values of camel milk. Int J Vet Sci Res, (2016); 2(1): 018-025. https://doi.org/10.17352/ijvsr.000009
5. Barłowska J, Szwajkowska M, Litwińczuk Z, Król J. Nutritional value and technological suitability of milk from various animal species used for dairy production. Comprehensive Reviews in Food Science and Food Safety, (2011); 10(6): 291-302. https://doi.org/10.1111/j.1541-4337.2011.00163.x
6. Salami M, Moosavi-Movahedi AA, Ehsani MR, Yousefi R, Haertle T, et al. Improvement of the antimicrobial and antioxidant activities of camel and bovine whey proteins by limited proteolysis. Journal of agricultural and food chemistry, (2010); 58(6): 3297-3302. https://doi.org/10.1021/jf9033283
7. Alavi F, Salami M, Emam-Djomeh Z, Mohammadian M (2017) Nutraceutical properties of camel milk. Nutrients in Dairy and their Implications on Health and Disease: Elsevier. pp. 451-468. https://doi.org/10.1016/b978-0-12-809762-5.00036-x
8. Al Kanhal HA. Compositional, technological and nutritional aspects of dromedary camel milk. International Dairy Journal, (2010); 20(12): 811-821.
9. Panwar R, Grover CR, Kumar V, Ranga S, Kumar N. Camel milk: Natural medicine-Boon to dairy industry. Karnal: ICAR National Dairy Research Institute, (2015); 10.
10. Lobo V, Patil A, Phatak A, Chandra N. Free radicals, antioxidants and functional foods: Impact on human health. Pharmacognosy reviews, (2010); 4(8): 118. https://doi.org/10.4103/0973-7847.70902
11. Kalla K, Manthani V, Keerthi S. Camel milk a white gold of dessert: a review. Inter Arch App Sci Technol, (2017); 8(3): 74-83.
12. Kanwar JR, Roy K, Patel Y, Zhou S-F, Singh MR, et al. Multifunctional iron bound lactoferrin and nanomedicinal approaches to enhance its bioactive functions. Molecules, (2015); 20(6): 9703-9731. https://doi.org/10.3390/molecules20069703
13. Khatoon H, Najam R (2017) Bioactive components in camel milk: Their nutritive value and therapeutic application. Nutrients in Dairy and their Implications on Health and Disease: Elsevier. pp. 377-387. https://doi.org/10.1002/9780813821504.ch6
14. Shamsia S. Nutritional and therapeutic properties of camel and human milks. International Journal of Genetics and Molecular Biology, (2009); 1(4): 052-058. https://doi.org/10.3390/molecules27227695
15. Akbar MA, Faraz A, Waheed A. Therapeutic Features of the Camel Milk-A Review.
16. Laila A-A, Halepoto DM (2017). Camel Milk as a Potential Nutritional Therapy in Autism. Nutrients in Dairy and their Implications on Health and Disease: Elsevier. pp. 389-405. https://doi.org/10.1016/b978-0-12-809762-5.00030-9
17. Swain BC, Mukherjee SK, Rout J, Mishra PP, Mukherjee M, et al. A spectroscopic and computational intervention of interaction of lysozyme with 6-mercaptopurine. Analytical and Bioanalytical Chemistry, (2020); 1-13. https://doi.org/10.1007/s00216-020-02483-1
18. Sakandar HA, Ahmad S, Perveen R, Aslam HKW, Shakeel A, et al. Camel milk and its allied health claims: A review. Progress in Nutrition, (2018); 20(Supplement 1): 15-29.
19. Rosa L, Cutone A, Lepanto MS, Paesano R, Valenti P. Lactoferrin: a natural glycoprotein involved in iron and inflammatory homeostasis. International journal of molecular sciences, (2017); 18(9): 1985. https://doi.org/10.3390/ijms18091985
20. Jayaram P, Roy G, Mugesh G. Effect of thione—thiol tautomerism on the inhibition of lactoperoxidase by anti-thyroid drugs and their analogues. Journal of Chemical Sciences, (2008); 120(1): 143. https://doi.org/10.1007/s12039-008-0017-0
21. Guan R, Roychowdhury A, Ember B, Kumar S, Boons G-J, et al. Structural basis for peptidoglycan binding by peptidoglycan recognition proteins. Proceedings of the

National Academy of Sciences, (2004); 101(49): 17168-17173. https://doi.org/10.1073/pnas.0407856101
22. Cock I. Camel milk components inhibits the growth of colon cancer cells. Pharmacognosy Communications, (2014); 4(1): 63.
23. Malik A, Al-Senaidy A, Skrzypczak-Jankun E, Jankun J. A study of the anti-diabetic agents of camel milk. International journal of molecular medicine, (2012); 30(3): 585-592. https://doi.org/10.3892/ijmm.2012.1051
24. Korish A. The antidiabetic action of camel milk in experimental type 2 diabetes mellitus: an overview on the changes in incretin hormones, insulin resistance, and inflammatory cytokines. Hormone and Metabolic Research, (2014); 46(06): 404-411. https://doi.org/10.1055/s-0034-1368711
25. Abdulrahman AO, Ismael MA, Al-Hosaini K, Rame C, Al-Senaidy AM, et al. Differential effects of camel Milk on insulin receptor signaling–Toward Understanding the insulin-like Properties of camel Milk. Frontiers in Endocrinology, (2016); 74. https://doi.org/10.3389/fendo.2016.00004
26. Mohammadabadi T. Camel Milk as an Amazing Remedy for Health Complications: A Review. Basrah J Agric Sci, (2020); 33(2): 125-137. https://doi.org/10.37077/25200860.2020.33.2.11
27. Rasheed Z. Medicinal values of bioactive constituents of camel milk: A concise report. International journal of health sciences, (2017); 11(5): 1.
28. Gizachew A, Teha J, Birhanu T, Nekemte E. Review on medicinal and nutritional values of camel milk. Nature and Science, (2014); 12(12): 35-41.
29. Ehlayel MS, Hazeima KA, Al-Mesaifri F, Bener A. Camel milk: an alternative for cow's milk allergy in children; 2011. OceanSide Publications. pp. 255. https://doi.org/10.2500/aap.2011.32.3429
30. Fiocchi A, Brozek J, Schünemann H, Bahna SL, Von Berg A, et al. World Allergy Organization (WAO) diagnosis and rationale for action against cow's milk allergy (DRACMA) guidelines. World Allergy Organization Journal, (2010); 3(4): 57-161. https://doi.org/10.1111/j.1399-3038.2010.01068.x
31. de Almeida C RR. Camel milk: Characteristics and perspectives for use in clinical practice. Revista chilena de nutricion, (2011); 38(2): 211-218. https://doi.org/10.5958/2277-8934.2014.00042.3
32. Cardoso RR, Santos R, Cardoso C, Carvalho M. Consumption of camel's milk by patients intolerant to lactose. A preliminary study. Revista Alergia de Mexico, (2010); 57(1).
33. Mohammadabadi T. Camel Milk; An Especial Remedy for Treatment of Autism.
34. Al-Ayadhi LY, Halepoto DM, Al-Dress AM, Mitwali Y, Zainah R. Behavioral benefits of camel milk in subjects with autism spectrum disorder. J Coll Physicians Surg Pak, (2015); 25(11): 819-823.
35. Khatoon H, Najam R, Mirza T, Sikandar B, Ishaq H, et al. Evaluation of anticonvulsant and neuroprotective effects of camel milk in strychnine-induced seizure model. Asian Pacific Journal of Tropical Disease, (2015); 5(10): 817-820. https://doi.org/10.1016/s2222-1808(15)60937-9
36. Yagil R. Camel milk and its unique anti-diarrheal properties. Isr Med Assoc J, (2013); 1535-36.
37. Quan S, Tsuda H, Miyamoto T. Angiotensin i-converting enzyme inhibitory peptides in skim milk fermented with lactobacillus helveticus 130b4 from camel milk in inner mongolia, china. Journal of the Science of Food and Agriculture, (2008); 88(15): 2688-2692. https://doi.org/10.1002/jsfa.3394
38. Gul W, Farooq N, Anees D, Khan U, Rehan F. Camel milk: a boon to mankind. Int J Res Stud Biosci, (2015); 323-29. https://doi.org/10.31142/ijtsrd15640
39. Al-Fartosi KG, Khuon OS, Al-Tae HI. Protective role of camel's milk against paracetamol induced hepatotoxicity in male rats. Int J Res Pharmaceut Biomed Sci, (2011); 21795-1799. https://doi.org/10.1016/j.gene.2019.143966
40. Darwish HA, Abd Raboh NR, Mahdy A. Camel's milk alleviates alcohol-induced liver injury in rats. Food and Chemical Toxicology, (2012); 50(5): 1377-1383. https://doi.org/10.1016/j.fct.2012.01.016
41. Kaskous S. Importance of camel milk for human health. Emirates Journal of Food and Agriculture, (2016); 158-163. https://doi.org/10.9755/ejfa.
42. Uversky VN, El-Fakharany EM, Abu-Serie MM, Almehdar HA, Redwan EM. Divergent anticancer activity of free and formulated camel milk α-lactalbumin. Cancer Investigation, (2017); 35(9): 610-623. https://doi.org/10.1080/07357907.2017.1373783
43. Korashy HM, El Gendy MA, Alhaider AA, El-Kadi AO. Camel milk modulates the expression of aryl hydrocarbon receptor-regulated genes, Cyp1a1, Nqo1, and Gsta1, in murine hepatoma Hepa 1c1c7 cells. Journal of Biomedicine and Biotechnology, (2012); 2012. https://doi.org/10.1155/2012/782642
44. Dubey US, Lal M, Mittal A, Kapur S. Therapeutic potential of camel milk. Emirates Journal of Food and Agriculture, (2016); 164-176. https://doi.org/10.9755/ejfa.2015-04-122
45. Levy A, Steiner L, Yagil R. Camel milk: disease control and dietary laws. Journal of Health Science, (2013); 1(1): 48-53. https://doi.org/10.17265/2328-7136/2013.12.006
46. Ravaghi M, Yousefi M, Hosseini SM, Zibaee S, Feyzabadi Z, et al. Camel milk could be helpful in the treatment of asthma. Traditional Medicine Research, (2018); 3(6): 307-312. https://doi.org/10.53388/tmr201814090
47. Salami M, Moosavi-Movahedi AA, Moosavi-Movahedi F, Ehsani MR, Yousefi R, et al. Biological activity of camel milk casein following enzymatic digestion. Journal of dairy research, (2011); 78(4): 471. https://doi.org/10.1017/s0022029911000628
48. Al-Humaid A, Mousa H, El-Mergawi R, Abdel-Salam A. Chemical composition and antioxidant activity of dates and dates-camel-milk mixtures as a protective meal against lipid peroxidation in rats. American Journal of Food Technology, (2010); 5(1): 22-30. https://doi.org/10.3923/ajft.2010.22.30
49. El-Bahr S. Camel milk regulates gene expression and activities of hepatic antioxidant enzymes in rats intoxicated

with carbon tetrachloride. Asian Journal of Biochemistry, (2014); 9(1): 30-40. https://doi.org/10.3923/ajb.2014.30.40

50. Akhmetsadykova S, Baubekova A, Konuspayeva G, Akhmetsadykov N, Faye B, et al. Lactic acid bacteria biodiversity in raw and fermented camel milk. (2015). https://doi.org/10.14303/ajfst.2015.026
51. Wernery R, Yagil R. Medicinal properties in camel milk for treatment of Epidemic Diseases; 2012. pp. 225-227. https://doi.org/10.1201/9781003261520-17
52. Rukkayya Y, Ibrahim S, Ladan M, Wasagu R, Jiya N. Therapeutic effects of camel milk to sickle cell anaemia patient. International Blood Research & Reviews, (2018); 1-7. https://doi.org/10.9734/ibrr/2018/38776
53. Ali AA, Alyan AA, Bahobail AS. Effect of fermented camel milk and cow milk containing (bifidobacteria) enriched diet in rats fed on cholesterol level. Agric Sci Res J, (2013); 3(11): 342-346.
54. Babilas P, Knie U, Abels C. Cosmetic and dermatologic use of alpha hydroxy acids. JDDG: Journal der Deutschen Dermatologischen Gesellschaft, (2012); 10(7): 488-491. https://doi.org/10.1111/j.1610-0387.2012.07939.x