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CAMEL MILK: A NATURAL ADJUVANT WITH MANY ANTIMICROBIAL PROPERTIES

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ABSTRACT

The present review aimed at camel's milk, its limits on healthy eating, its antimicrobial properties, and the effect on human treatment. Milk is essentially a balanced diet and is rich in nutrients and a great product for health. The research shows that camel milk is more capable in every aspect than any other milk. Camel milk is very cost-effective, but it also has many advantages, such as the longevity of milking and the ability to adapt to different climates. The current studies show that camel milk is easily available in every climate and also is very beneficial than other milk. Camel milk is called as natural adjuvant and used immensely in various parts of world for the treatment of various human diseases. There were various antibodies, insulin, antioxidants, and antimicrobial properties that give special characteristics features to it. Camel milk has unique properties that inhibit the growth of microorganisms as it contains protective proteins such as lactoferrin, peptidoglycan protein, and various others. Thus, we are highlighting the fact that camel milk is a good substitute instead of other milk and has much nutritional quality and antimicrobial properties.

Keywords: Camel milk, antimicrobial properties, nutrient, proteins, enzymes, disease

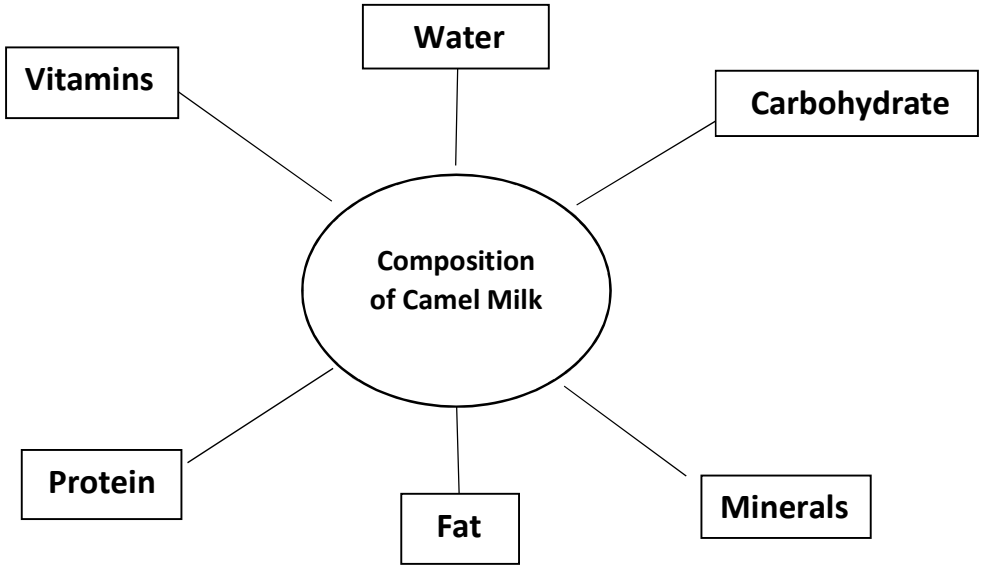
INTRODUCTION

The worldwide camel population across 47 countries, is estimated to be around 26.99 million. India positions tenth in the world with 0.38 million camels. The main reasons for the continued decline in the price of camels in India are a sharp decline in the traditional use of camels for logistics, agricultural use, and mountain degradation **[1]**. Indian camels produce 3.5 kg to 10 kg of milk per day **[2]**. Camels do not store their milk as cow does. A camel can produce or cut off its milk at its self will **[3]**. Camel milking is reported to vary from two to six times a day depending upon the time of year, the lactation phase, and the milk yield **[4]**. Milk is said to be an important part of our daily diet. It is the most nutritious part of a healthy life. Generally, there is excessive use of buffalo and cow milk in India. But buffalo and cow milk have their limitations like having high lactose content, high-fat content, may produce allergies, can be contaminated easily. Globally, camel milk is gaining more recognition as a portion of healthy and nutritious food, so, in Sudan and elsewhere the market demand for the product is growing rapidly, as a result; the use of camel milk is greatly increased **[5]**. The camel milk contains a very low level of microorganisms and is considered sterile milk as compared to others **[6]**. Current researches are being conducted to investigate the quality of camel milk. Wide variation was observed with the green quality of camel milk **[7]**. Camel's milk is known for its high-protein content, which has the potential to protect and fight microorganisms **[1]**. Camel milk with desert gold is more similar to human milk than any other milk because it contains lower cholesterol, low sugar, high minerals (sodium, potassium, iron, copper, zinc, and magnesium), high vitamin C, protective proteins such as lactoferrin, Lactoperoxidase, immunoglobulins, lysozyme **[8]**. LAB (Lactic acid bacteria) separated from camel milk plays a protective role in both Gram-positive and Gram-negative viruses. In addition, LAB can be used as a probiotic and restore the oxidative state caused by various bacterial infections **[9]**. Recently, studies have confirmed that camel milk differs in its antimicrobial properties, antibacterial, antiviral, antifungal, anti-aging, and anti-inflammatory. Camel milk has long been approved to provide a possible treatment for a series of diseases such as dropsy, jaundice, anti-hypertensive, asthma, and leishmaniasis. However, it contains insulin-like and protective proteins that are used to treat many ailments such as diabetes, autism, and diarrhea and to have antibodies **[8]**.

The purpose of this paper is to update current information on the nutritional and anti-microbial properties of camel's milk.

COMPOSITION OF CAMEL MILK

- Camel's milk contains a lot of minerals and vitamins, especially iron, vitamin. C and vitamin B. saline properties such as anti-bacterial, antiviral, and antitumor properties are due to the presence of lactoferrin in camel's milk. Zinc is found in large amounts in camel's milk, the rapid production of immune cells that are sensitive to zinc deficiency **[1]**.
- Camel's milk is usually a white opaque liquid and has a pleasant aroma and sharp taste; sometimes there is probably even salt to taste. Its oily white opaque color has been enhanced throughout the milk, and a change in taste is due to the fodder type and the availability of drinking water **[8]**.
- The composition of milk depends on a variety of factors such as type, nutritional status, management, balance, age, body condition and time of year, etc. The composition of milk and the highly modified quality are many factors such as genetics, body (age, body weight, breastfeeding stage), milking methods, and management. The composition of milk is most affected by the breastfeeding phase **[10]**.
- The average size of camel's milk is 1.029 g cm-3 **[11]**. The viscosity of camel milk at 20C is 1.72-mPa s. The pH of fresh camel's milk ranges from 6.4 to 6.7. The freezing point of camel's milk is between -0.57 C and -0.61 C. Sticky milk is below the acquisition limit.



Flowchart(a): Showing the composition of camel milk

Table 1: Summarized table on Composition of camel milk with their percentage

COMPONENTS	PERCENTAGE
WATER CONTENT	86%
CARBOHYDRATE	3.3% - 5.80%
PROTEIN	3.7%
FAT	4.95%
LACTOSE	5.1%
CALCUIM	1000-1400 mg/m
PHOSPHORUS	0.650-1.10 mg/L
CARBOHYDRATE	3.3% - 5.80%
TOTAL SOLIDS	9% - 13%

Source – [Ulrich Wernery. Camel milk-the white gold of desert [3], Kula J. Medicinal values of camel [8], Faraz A. Composition of Camel milk [10], Muhammad A.R, Khalid W, Fizza C, Tariq A, Hassan A, Rauf A, Aziz A, Muhammad Modassar Ali N. Nutritional composition and Medicinal properties of Camel Milk, and cheese processing] [12]

1. WATER

- Water is the most important ingredient in camel's milk. Unlike other animals, the water content of camel's milk increases during dehydration.
- With free water, the milk content is 86%, but when water is restricted the milk content rises to 91%.
- This is useful as a water source for dehydrated calves and people in areas where water is scarce.
- The reasons for the increase in the water content of dehydrated camel's milk are the ADH secretion suggested in the dehydrated chamber, the decrease in fat content, and the type of flour consumed **[8]**.

2. PROTEINS

- Milk proteins are a complex group of compounds that differ in composition and structure.
- Dromedary camel's milk contains 3 to 3.90 percent of protein. It contains two major groups (Caseins and Whey protein and the body's highest protein (Peptidoglycan Recognition Protein, Lactoferrin Lysozyme, and Lactoperoxidase) and insulin.
- Camel's milk contains high protein (especially casein) and low whey milk than human milk. Casein is a major component of camel's milk. There are 4 casein particles in the major components of the casein: αs1-, αs2-, β-, and κ protein is expressed in many species of animals.
- Camel contains 20 to 25 percent of the protein of camel's milk. Dromedary camel's milk contains whey protein in the range of 0.63 and 0.80 percent.
- β -lactoglobulin is found in trace, while α-lactalbumin contains a large proportion of camel's milk and recognition proteins, Immunoglobulins, lactoferrin, and serum albumin **[8]**.

- Peptidoglycan recognition protein (PGRP), recognized as a known enzyme in camel's milk. This enzyme had extensive antimicrobial actions and the ability to regulate tumor metastasis **[12]**.
- Proteins and peptides contained by camel milk have a beneficial effect on biological processes such as digestion, absorption, growth, and immunity **[13]**.

3. CARBOHYDRATE

- Lactose is the main carbohydrate in milk. The lactose content of camel's milk is between 2.40 and 5.80%.
- The diversity is because camels often feed on a variety of dried herbs and salt plants found in the desert. It remains unchanged during the year and under wet or dehydrated conditions although it is only found that it changes the camel's milk slightly in other types of camels in different parts of the world **[1]**.
- The vegetation of the desert camels can be a key factor in the significant change in lactose content **[8]**.

4. FATS

- Camel milk fat has a low carotene content. The cholesterol content of camel's milk is 5.64 ± 3.18 mg / 100 g, SD. The fat content of cow's milk is high and the cholesterol / fat ratio is the same for the two types (camel: 225 ± 125 mg / 100 g fat; cow 211 ± 142 mg / 100 g fat) **[1]**.
- It was observed that the total content of solids present in camel milk is directly/indirectly responsible for the variation in fat content **[7]**.
- In dairy camel milk the fat content is 1.2% -6.4%.
- The content of chain fatty acids is higher in camel's milk as compared to fatty acids. Essential lipid, linoleic acid, and other fat-free acids for camel's milk, ready for nutrition **[12]**.
- Camel's milk also differs in terms of its fatty acid content which contains three to eight times as much as fatty acids.
- Many different acids such as butyric, caproic, caprylic, capric, lauric, myristic, myristate, palmitic, palmitoleic, stearic, oleic, linoleic, and arachidic acid are present in camel's milk **[14]**.

5. VITAMINS AND MINERALS

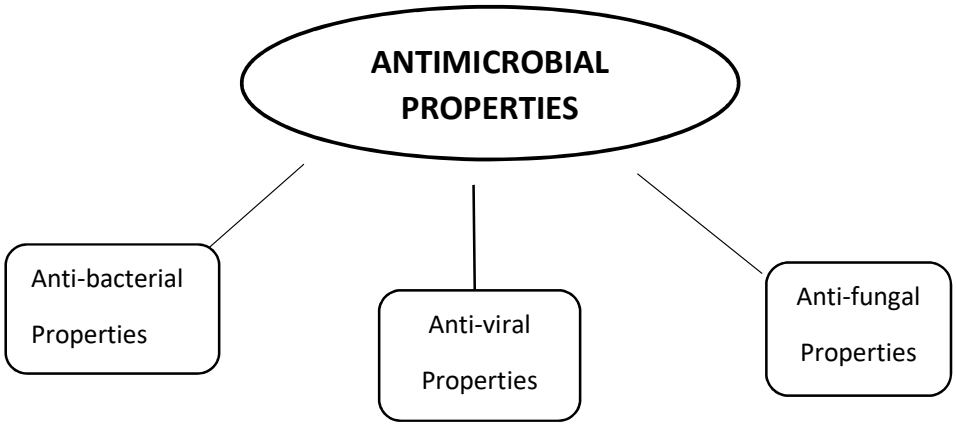
- The availability of high vitamin C content in raw camel milk is very important from the diet as vitamin C exhibits strong antioxidant activity and can be another source of vitamin C under natural conditions in arid and semi-arid regions.

- Vitamin B1, B2, folic acid, and pantothenic acid are low in camel's milk. Vitamin A, E, and B1 levels are reported to be low in camel's milk.
- Total mineral milk for camels is between 0.60 to 1.0 percent. There is a significant variation in mineral levels due to differences in nutrition, fertility, water infiltration. Camel's milk is a rich source of various minerals such as Na, K, Ca, P Mg Fe, Zn, Cu present in camel's milk.
- Camel's milk is a rich source of chloride because of the fodder consumed by camels such as Atriplex and Acacia, which are often salty and maybe one of the reasons for the salty taste of milk **[1]**.
- Many vitamins such as D, E, A, C, and B group vitamins are found in the milk of dromedary camels.
- The average concentration of vitamin C in camel's milk is 34.16 mg. L-1 **[8]**.

❖ **Other properties of Camel Milk**

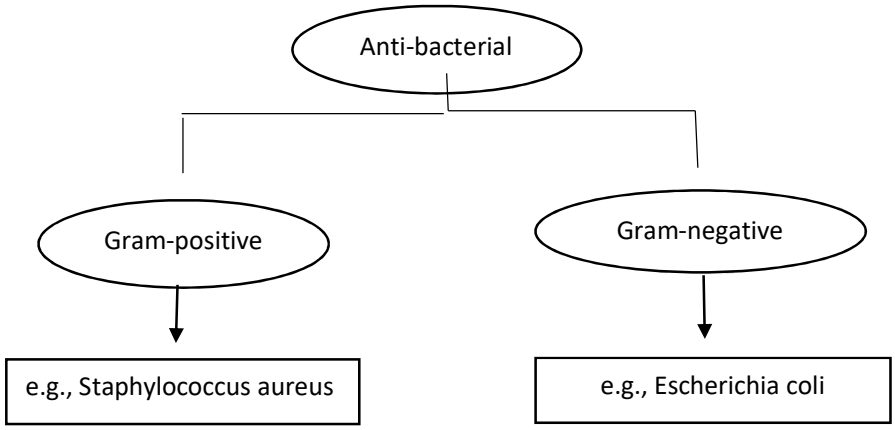
ANTIMICROBIAL PROPERTIES

- Lactoferrin-rich camel's milk contains effective anti-bacterial and anti-inflammatory properties that include microbial inhibition, anti-bacterial effects, herpes simplex virus, HIV, anti-rot effects (Candida albicans), support immune system, immune-modulatory energy, regulated maturation, activation of neutrophils, maturation and lymphocyte utensils, and anticancer actions
- Camel milk antibodies are powerful and selective chemical agents of the viral enzyme system **[12]**.
- Limited studies have been done on antimicrobial activity of camel milk proteins and their hydrolysates. Camel caseins were enzymatically milled, and the milled sample was tested for its antibacterial activity against Gram-negative (Escherichia coli) and Gram-positive bacteria (Listeria monocytogenes, Bacillus cereus, and Staphylococcus aureus).
- There is a need for in-depth testing of antimicrobial properties of camel's milk whey protein hydrolysates using various proteolytic enzymes and test conditions and to test them against a variety of pathogenic microorganisms in vitro and vivo **[15]**.



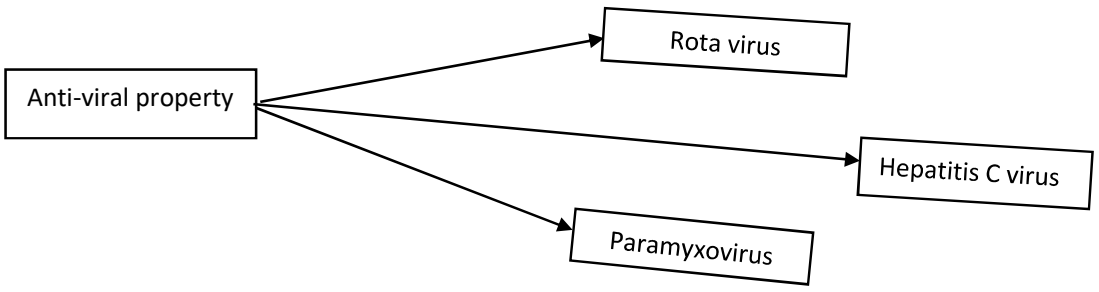
Flow chart (b): Showing the various antimicrobial properties present in Camel Milk

- **ANTIBACTERIAL PROPERTIES**
  - Camel milk is reported to inhibit gram-positive and gram-negative bacteria, including Escherichia coli, Listeria monocytogenes, *Staphylococcus aureus*, etc.
  - The growth of Salmonella typhimurium is inhibited by lactoferrin in camel milk by binding iron and making it unaffected by its growth.
  - It has been shown that camel's milk lactoferrin ability to block HCV entry into human leukocytes is more efficient than human or animal lactoferrin **[1]**.
  - The literature has shown that lactoferrin can act as a bacteriostatic and or bactericidal agent. Al-Majali reported a study of protective proteins against gram-negative and gram-positive bacteria and rotavirus.
  - Studies performed on the release of Lysozyme, lactoferrin, lactoperoxidase, Immunoglobulins G, and Immunoglobulins secreted were extracted from the milk of camels and the activity of these protective proteins was measured with *Lactococcuslactis subsp. Escherichia coli, Staphylococcus aureus*, and *rotavirus*.
  - The result concluded that LP camel's milk was bacteriostatic compared to Gram-positive and bactericidal strains against Gram-negative cultures and Immunoglobulins had little effect on bacteria **[8]**.



Flowchart(c): Showing the anti-bacterial properties of camel milk that inhibit the growth of gram-negative and gram-positive bacteria

- **ANTIVIRAL PROPERTIES**
  - Rotaviruses are the most common cause of nonbacterial gastroenteritis in children or calves in many parts of the world. Camel-extracted immunoglobulin (IgG) and secret immunoglobulin A (IgA) have been reported to be effective in rotaviruses isolated from cattle. The activity of anti-rotavirus, i.e., antibody titter in colostrum, was potent due to IgG, while IgA in normal milk was higher. This suggests that raw camel's milk is considered a potent inhibitor of viral rotavirus in humans.
  - These findings may explain the use of camel's milk as a cure for diarrhea by herders. The newly prepared or preserved 'Shubat', a camel milk drink used in Kazakhstan, has been reported to have anti-virucidal and anti-viral properties against ortho- and paramyxoviruses. These properties are maintained during storage. 'Shubat' is suggested to be having antiviral activity due to the presence of sialic conjugates and metabolic products of lactic acid bacteria and yeast.
  - The lactoferrin camel demonstrated an amazing in vitro ability to completely prevent HCV infiltration and replication in human mononuclear cells (PBMC), hepG2, and replicate within those cell systems **[1]**.

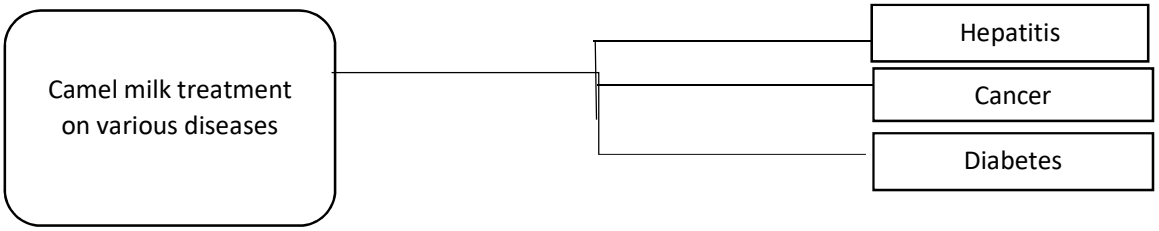


Flowchart(d): Showing the Anti-viral property of Camel Milk against some viruses

❖ **CAMEL'S MILK FOR TREATMENT OF VARIOUS DISEASES**

i. Hepatitis

- Scientific literature has shown that camel's milk cures both hepatitis B and hepatitis C.
- Special oils of camel's milk soothe the liver and have beneficial effects on chronic liver patients. Camel's milk can help to improve liver function by having the high concentration of ascorbic acid in it.
- However, subsequent studies have shown that camel milk lactoferrin significantly inhibits the transmission of the hepatitis C 4 virus by preventing the entry of the virus into cells **[8]**.
- Camel's milk contains various therapeutic properties for various bacterial infections. Camel's milk contains anti-bacterial, anti-virus, anti-fungal properties. It is used for many diseases some of which are described here. Chronic liver disease has affected 180 million people, mainly caused by Hepatitis C Virus, and is increasing daily.
- Lactoferrin present in camel milk has antimicrobial activity and has therefore shown promising results in the treatment of herpesvirus 1 (HSV1) and herpesvirus 2 (HSV-2) **[16]**.
- Lactoferrins block cellular receptors from binding to HCV. The results of the study showed that the camel milk lactoferrin destroyed HCV at the onset of infection and its N and C class inhibited HCV activity **[16]**.
- Camel's milk is reported to possess antibodies Immunoglobulin and lactoferrin separated from camel's milk can prevent hepatitis C virus and show it to be effective proof against its synthetic peptides, while its human counterpart did not do so **[17]**.



Flowchart(e): Showing the diseases that can be treated by using Camel Milk

- Diabetes affects millions of people worldwide. It is an incurable condition where the body is unable to produce enough insulin; you cannot use the

insulin produced or your combination of both.

- Clinical studies and murine models have shown that the use of camel's milk in a type of diabetic type lowers blood glucose levels.
- Although this mechanism is not well understood, camel's milk appears to contain insulin-like protein-resistant protein, which rapidly enters the bloodstream, carries large amounts of lipid micelles, and has different content of casein. Recent studies have reported the main effect of camel's milk protein on the insulin receptor activity expressed in HEK293 cells.
- A study by Jakubowicz and Froy suggested that whey proteins and their hydrolysates can promote gut in vivo by releasing bioactive peptides and amino acids, thus helping to regulate glycemia. In addition, these peptides can act as dipeptidyl peptidase-4 (DPP-IV) inhibitors in vivo.
- Many DPP-IV inhibitory peptides have been isolated and identified in cattle casein since it has been helpful in type 2 diabetes treatment.
- These studies of hydrolysate camel milk protein provide strong evidence that a fraction of camel protein on hydrolysis may have effective anti-diabetic functions **[15]**.
- It has been demonstrated that type 1 diabetes results in a reduction in dose of insulin and control glycemic control by consumption of camel milk. Therefore, it can be used as a substitute in the management of type 1 diabetes **[18]**.
- Camel's milk contains essential elements that work with insulin as an anti-diabetic action and its complications but how these effects occur, is still unclear **[19]**.

ii. CANCER

- Lactoferrins present in camel's milk inhibits the production of cancer cells and repair the damaged DNA. Lactoferrin has the potential to reduce cancer cells by up to 56%. Apoptosis and oxidative stress-mediated mechanisms are initiated by HepG2 present in camel's milk.
- Fatin reported that camel's milk stopped the growth of cancer cells such as lung cancer cells, colon carcinoma, hepatocellular carcinoma, leukemic cells, and human glioma cells.
- The anti-cancer action in camel's milk could be an anti-angiogenic action and direct cell cytotoxicity.
- Camel's milk contains anti-inflammatory properties due to its anti-oxidative and anti-microbial functions

that help reduce inflammation of the liver.

- Camel's milk also has a strong thrombolytic effect, which inhibits fibrin formation and thickening and inhibits the growth and proliferation of metastatic tumor cells **[16]**.

❖ **MEDICINAL PROPERTIES OF CAMEL MILK**

- Many children and adults agonize from food allergies. With camel's milk free of allergies and immune system regeneration, children recover in their vessels.
- According to research, using camel's milk for babies recovers from their bodies with no side effects.
- Researchers say that the results were amazing in comparison with traditional medicine.
- Fighting disease Immunoglobulins in camel's milk were believed to play a key role in reducing the symptoms of allergies **[20]**.
- Camel milk is also very useful for chubby the skin and smoothies the skin's fine lines as it contains Alpha-Hydroxide acids.
- Camel´s milk has several antibodies that are compatible with human ones and very small molecules that can easily enter the bloodstream by the intestines.
- It improves the life of people with autoimmune disorders. Helping the immune system respond properly and no longer attack a person's body tissues **[21]**.

CONCLUSION

Concerning the science of the camel, the number of books involving the camel is constantly increasing, but there is still a lack of lessons about important challenges regarding the camel, especially in the local economy, improvements in milk and meat production, many diseases, and environmental interactions. Camel's milk is rich in health benefits, by having some abundant compounds that is useful for healthy life, and mono and polyunsaturated fatty acids. Whey protein is essential for a healthy diet as it provides essential energy and amino acids, and the importance of function as it helps in the formation, structure, and development of a complete diet. Camel Milk Wheel is an excellent source of nutrients and important bioactive peptides. Antibiotics, anti-cholesterol activities all represent a large number of these bioactive peptides.

Camel's milk is unique in that it contains a variety of protective proteins such as lysozyme, lactoferrin, lactoperoxidase, immunoglobulins, antioxidants, antibacterial, antiviral, antifungal, hypoglycemic, antiparasitic, growth and

immunity, and anti-inflammatory activity. Awareness and use of camel's milk as a health adjuvant is slowly increasing as camel's milk is found to have different properties of its proteins, fatty acids, rich in microminerals and vitamin C. Economic and social milk of camels and products. This review is expected to open up new avenues for the development of modern camel dairies and highlight greater interest in the study of camel milk.

Camel's milk is a source of natural antibodies such as protein, vitamin C, phosphorus, calcium, and niacin and meets the daily needs of a healthy human diet. Concluding that based on the results of research reviews on the use of camel's milk in various studies, camel's milk is strongly recommended in the treatment of various diseases such as diabetes, type first disease as it acts as a blood sugar controller in the absence of insulin, liver diseases such as hepatitis C, autoimmune diseases, various childhood diseases such as diarrhea, lactose intolerance, food allergies, autism and milk allergy, MDR tuberculosis and tuberculosis, anti-cancer, anti-tumor and anti-ulcer effects, anti-aging, and cosmetic agent. Many trials are needed to support these conclusions. Researchers have high confidence in these reports that will lead to the development of research studies on camel's milk and its therapeutic benefits for various diseases.

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