

# Medicinal values of bioactive constituents of camel milk: A concise report

Zafar Rasheed

Department of Medical Biochemistry, College of Medicine, Qassim University, Saudi Arabia

**Address for correspondence:**

Zafar Rasheed, MS., Ph.D., PGDCA,  
Department of Medical Biochemistry,  
College of Medicine, Qassim University,  
P.O. Box 6655, Buraidah-51452,  
Kingdom of Saudi Arabia.  
E-mail: zafarrasheed@qumed.edu.sa

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The past decade or two have seen a dramatic increase and growing interest in the use of camel milk for its medicinal values and now bioactive ingredients of camel milk have gained significant attention of scientists from all over the world to study their potential health benefits.<sup>1-3</sup> Due to the increase of global demand of camel milk, camel husbandry has now been extensively increased in various regions of the world particularly in Asia and Africa. Camel milk and its products such as laban, ice cream, and chocolates are currently available in the local markets of all over the gulf countries and now have almost started to supply globally.<sup>2-5</sup> Scientifically, it has been proved that camel milk ingredients are excellent for nutritional view point as it contains high proportion of anti-bacterial and anti-viral substances.<sup>4-6</sup> Camel milk ingredients such as lactoferrin, immunoglobulins, lysozyme, B Vitamins, Vitamin C, minerals, and iron have been studied for their medicinal properties in patients with different disorders ranging from diabetes to cancer.<sup>2-13</sup> It is much more nutritious than milk from cow, buffalo, sheep, etc., as it contains low levels of fat or lactose contents, and high levels of volatile acids, especially linoleic acids and polyunsaturated acids.<sup>2,3</sup> Not only have these, camel milk also contains high concentrations of potassium, magnesium, copper, sodium, zinc, iron, B Vitamins, Vitamin C, etc.<sup>2-5</sup> Regular drinking of camel milk makes immune system stronger as it contains series of protective proteins such as lysozyme, lactoferrin, lactoperoxidase, immunoglobulin G, and immunoglobulin A.<sup>3,14</sup> Camel milk lacks  $\beta$ -casein and other major allergens, which are present in cow milk that might prevent children from allergic disorders.<sup>3,11</sup> Moreover, camel milk is an excellent source of  $\alpha$ -hydroxy acids, which are very famous for treatment of skin disorders.<sup>3</sup> Importantly,  $\alpha$ -hydroxy acids are also frequently used by cosmetic industries for manufacturing of their products for wrinkles treatment as well as for soften of skin, and for overall improvement of the skin quality.<sup>15</sup> Reports have shown that total protein contents including whey proteins in camel milk are significantly more than milk from other sources,<sup>3-5</sup> this might be the reason for

its effect on reducing risk for the onset of disorders such as diabetes, heart disease, and cancer.

As a medicinal point of view, camel milk has mainly two active ingredients lactoferrin and immunoglobulins.<sup>1-18</sup> Number of studies on camel lactoferrin reported that it has anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, anti-oxidant, anti-tumor properties, etc.<sup>2,3</sup> More specifically, it inhibits growth of *Escherichia coli*, *Klebsiella pneumonia*, *Clostridium*, *Helicobacter pylori*, *Staphylococcus aureus*, *Candida albicans*, etc. Furthermore, camel lactoferrin also has anti-pathogenic activity against human immunodeficiency virus, hepatitis B and C, cytomegalovirus, herpes simplex virus-1 infection.<sup>3,10</sup> Not only have these, camel lactoferrin has immunomodulatory roles, as it modulates activation and maturation of various immune cells such as neutrophils, macrophages, and lymphocytes.<sup>2,3</sup> Most importantly, lactoferrin is the main ingredient of camel milk, through which camel milk perform anti-pathogenic activity against proliferation of cancer cells; however, mechanisms behind remain to be investigated.<sup>17</sup> Recently, I along with some of my colleagues have investigated that camel lactoferrin has cartilage protective and anti-arthritis activity,<sup>1</sup> at it showed anti-inflammatory activity against interleukin-1 $\beta$ -induced activation of human osteoarthritis chondrocytes through blocking of nuclear factor kappa B signaling events.<sup>1</sup> In the same study, we also have also shown that it inhibits cyclooxygenase-2 expression and prostaglandin E2 production in stimulated human osteoarthritis chondrocytes.<sup>1</sup> These novel actions of camel lactoferrin are of important to know the mechanisms behind its anti-inflammatory or anti-arthritis effects.

Immunoglobulins from camel milk are also very important therapeutically because of their unique property of containing only two heavy chains, as the light chains are absent.<sup>17,18</sup> Because of this reason, most of these immunoglobulins from lactating camel can pass within the milk; therefore, these

immunoglobulins are remain available in the camel milk.<sup>2,3</sup> Moreover, heavy chain of immunoglobulins are currently using in the immune therapy for patients with various disorders such as cancer, multiple sclerosis, and Alzheimer's disease.<sup>2</sup>

Furthermore, camel milk also contains insulin-like protein, which is assumed to carry out anti-diabetic activity.<sup>12-14</sup> It also contains higher proportion of zinc as compared to the zinc level present in the milk from other sources such as cow, which significantly enhanced insulin interaction with its receptor.<sup>3</sup> Investigators have been reported that the amino acid sequence of insulin-like protein from camel milk is rich in cysteine residue, which has a similar feature of insulin family of peptides.<sup>13,16</sup> Most importantly, it is important to point out that mucosal surfaces are the most common pathways for drug delivery to the humans and the oral administration of insulin was failed repeated to pass through mucosal barriers before entering into the bloodstream as it has been degraded by digestive enzymes.<sup>3</sup> Insulin-like protein from camel milk has a unique property of encapsulation inside the nanoparticles such as lipid vesicles that protect it from digestive enzymes in the stomach to reach the target.<sup>12</sup> Because of this lipid encapsulation, camel milk has not been coagulated in an acidic environment of the stomach and most interestingly, it has a better buffering capacity than milk from other species such as cows, buffalo, and goat.<sup>3,12</sup> Taken all together, these studies identify and support the use of camel milk and its bioactive gradients as possible preventive agents with a potential to inhibit the development of various disorders ranging from diabetes to cancer. However, further studies are required to know the mechanisms behind their therapeutic actions.

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