

Camel Milk a Significant Alternative Diabetes Therapeutic

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Abstract

Camel milk, which has been used medically by migrant people for centuries, has been reported for the last twenty years in the treatment of human disease. Diabetes mellitus is one of the most common metabolic diseases worldwide. In patients with diabetes, insulin sensitivity and glucose homeostasis deteriorate and cause hyperglycemia. Various *in vivo* and *in vitro* studies have shown that camel milk with various mechanisms can improve hyperglycemia and subsequent complications in diabetic patients and experimental animals. But there is a complex metabolism involving different cell types, enzymes and receptors. Future studies on the complex subject will help to understand the mechanism of effect of camel milk on diabetes.

Keywords: Camel milk; Compound; Diabetes; Mechanism; Treatment

Introduction

Composition of camel milk

The Arabian camel (*Camelus dromedarius*) is an significant dairy animal in the Arabian and Indian province and rural areas of northeastern Africa [1]. Camels are often found in environments where environmental conditions are more challenging than the cattle-feeding region, and they can bring about more milk than cattle. Camels should be milked in the place where the offspring is located. Milking usually begins 3 months after birth and can continue for 12 - 18 months. Even if water availability is limited, camels continue to breastfeed [2]. Milk yield varies depending on environmental conditions [3]. Conditions affecting milk yield include milking frequency, suckling, lactation period, calving interval, feeding, and region. There may be an average daily yield of 1 - 2 kg and 1000 - 1500 kg per lactation [4], but 6 and even 12 kg per day have been reported with feed supplementation. Camel milk contains 4.9% fat, 3.7% protein, 5.1% lactose, 0.7% ash, 14.4% total solids. The composition of camel milk differs considerably from cow's milk; these do not include milk-lactoglobulin, which similarly to human milk. Camel milk is particularly valuable in terms of biological activities of protective proteins in milk, lysozyme, lactoferrin, lactoperoxidase, antiviral activities and not causing allergies [5]. Allergic effects of camel milk are minimal or absent due to the low content of b-lactoglobulin [6,7] and-casein [7], which is a distinctive feature of camel milk [8]. Although the amounts of B1, B2, folic acid and pantothenic acid are low, B6 and B12 contents are similar to cow's milk, but are higher than human milk. Camel milk is rich in niacin and vitamin C than cow's milk. and has a high level of vitamin C. Similar to other species, glutamic acid is the basic amino acid, but lysine is present at low levels in camel milk. In general, the amino acid composition of camel milk proteins is similar to that of cow, buffalo, sheep and goat milk. The ratios of non-essential amino acids to essential ones are very close in the milk of all species; for camels, cows, buffaloes, goats, sheep, donkeys, mare and human milk are respectively 0.93, 1.00, 1.06, 1.02, 0.95, 0.99, 1.03 and 1.07 [9]. Camel milk proteins are reported to contain balanced amino acids for human diets. Because of the amino acid differences between human and cow's milk, cow's

milk feeding causes feeding problems in some babies. The cystine: methionine ratio and taurine value of human milk is higher than that of cow's milk and there is no taurine in cow's milk [10]. Phenylalanine: tyrosine ratios are 0.7, 2.7 and 2.5 for human, cow and camel milk, respectively. The caloric value of camel milk is 701 Kcal/liter and cow's milk is 665 Kcal/liter. The levels of Ca, P, Mg, Na, K, Zn and Mn of camel milk are similar to cow's milk, but are richer in Cu and Fe. In addition, camel milk contains higher levels of carnitine (Vitamin CT) (410 nmol/L) than cow's milk (235 - 290 nmol/L) [11]. Camel milk can meet important parts of daily essential acid need in humans. The minimum daily calcium or phosphorus requirements for minerals (800 mg) are easily met with 2.5 and 4 cups for Ca and P, respectively. Camel milk has been reported to successfully stabilize diabetes in children [12]. This is confirmed by the presence of insulin-like protein in camel milk [13]. Camel milk; compared to other species (cow 0.67, buffalo 0.63, goat 0.70, sheep 0.55 and human 0.86) contains high levels of IgG (1.64 mg/ml) [9].

Effects of camel milk on diabetes

Camel milk has been shown to have anti-bacterial, carcinogenic, anti-oxidant, anti-hypertensive, and anti-diabetic effects in many *in vitro* and *in vivo* studies [16-21]. Certainly, the hypoglycemic effects of camel milk have been proven in many *in vitro* and *in vivo* studies and studies on diabetes mellitus and related complications have been continued. Accordingly, *in vitro* and *in vivo* studies using type 1 or type 2-diabetic animal models (rats and rabbits), as well as in diabetic patients, have been observed to decrease blood sugar levels, increase insulin secretion, reduce insulin resistance and improve lipid profiles [17,22,23]. For many years, strong evidence has been collected on the beneficial effects of camel milk on glucose homeostasis in both human and animal diabetic models. Two important aspects of camel's milk have been identified that play a role in its beneficial effects on diabetes. These were insulin synthesis and secretion and insulin receptor function. Molecular and cellular aspects of these effects; it acts as an insulin receptor in insulin-sensitive tissues and acts directly on glucose transport, the direct and/or indirect effects of pancreatic β cells on insulin secretion, and the overall activity and development of pancreatic cells [24].

Type 1 diabetes mellitus is an organ-specific autoimmune disease characterized by impaired fat and protein metabolism and insulin deficiency. Diabetes is a common disease that prevents normal development in children and causes serious complications in the early stages of life. In this respect, prevention and early treatment are vital [25]. When taken orally, insulin cannot cross the mucosa and is disrupted by digestive enzymes before they are introduced into the bloodstream [26]. It has been found that one of the camel milk protein which mimic insulin interaction with its receptor, and it has a higher content of zinc [27] which has a key role in insulin secretory activity in pancreatic β cells has many similar properties to insulin [13] and does not coagulate in acidic medium [28]. The absence of this clotting allows the rapid passage of camel milk and specific protein/insulin, making it available for absorption in the intestine and it has a higher buffering capacity than the milk of other ruminants [29]. In a study, camel milk contained 3 times more insulin-like protein than cow's milk. These insulin-like proteins show that the amino acid sequences of camel milk proteins, such as some insulin family peptides, are also rich in half-cystine [27].

Camel milk in radioimmunoassay high concentration of insulin, (52 units/liter) has been revealed to contain [30]. Insulin concentration in human milk is also significantly higher (60.23 ± 41.05 micro u/ml) [31], but is probably unsuitable for intestinal absorption due to clotting in the stomach. In clinical studies, it has been reported that the use of camel milk in patients with Type 1 diabetes reduces blood sugar levels and insulin requirements by 30% [32].

Although recent studies have shown the benefit of camel milk on diabetes in improving glycemic control and reducing insulin resistance [33,34], the anti-diabetic effect of camel milk has not yet been fully explained [35]. The anti-diabetic components of camel milk, the mystery behind the beneficial effects of camel milk is still unknown, as the molecular and cellular mechanisms involved are still not fully resolved [24]. For example, it was reported that it could increase serum insulin concentration in patients with camel milk, T2DM (type 2 diabetes mellitus), FBS (fasting blood sugar), lipid profile and blood pressure changes, but there was no statistically significant difference between the two milk groups. These results show that camel milk can help control insulin levels in patients [36].

Conclusion

Despite the surprising anti-diabetic properties of camel milk, there is still great uncertainty between *in vivo* data on the cellular and molecular mechanisms of action in diabetic patients and animal models. These mechanisms may vary in complexity due to the application of different cell types (pancreatic a and b cells, liver, immune cells) and some important enzyme, various receptors (insulin, glucagon, and cytokines/chemokines), and other signal proteins. Several mechanically based studies provide remarkable data on the beneficial effects of camel milk proteins on diabetes and support the biological and pharmacological effects on enzymes and receptors. However, these data are still not sufficient to fully understand the mechanisms of action of camel milk and to identify active anti-diabetic agents in camel milk.

In future studies, more cellular and molecular research on dissection of cells should be carried out to help better understand the hypoglycemic effects of camel milk.

Declarations of Interest

None.

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