

Camel Milk; A Superfood for Diabetic Patients

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Abstract

Camel milk is rich in many nutrients that are important for overall health. Camel milk is also high in antioxidants, which help to prevent damage to your cells, leading to severe diseases such as cancer, diabetes, and heart diseases. Camel milk has anti-diabetic activity, possibly due to the presence of insulin-like protein (about 52 units/liter) is covered by fat micelles and can be an effective alternative for insulin to treat type 1 and 2 and gestational diabetes. Camel milk may prepare about 60% of the insulin in diabetic patients and reduce blood sugar and required insulin dose about 30 - 35% in type 1 diabetes patients. Raw camel milk has immune-modulatory effects on beta-cells of the pancreas, increase insulin secretion, reduces required insulin and insulin resistance and improves the glycaemia control in type 1 diabetes patients. Lactoferrin of camel milk has immune-modulatory effects on pancreas beta-cells and reduces required insulin doses in diabetes 1 and 2 patients. In most of the clinical trials, the favorable effects of raw camel milk on diabetes mellitus observed which also improve risk factors such as liver and kidney failures and cardiovascular challenge derived from diabetes mellitus. It appears that more scientific studies are needed to confirm the effectiveness of processed and camel milk powder on diabetes cases. It has been proved that camel milk is safe and effective in improving long-term glycemic in human patients and animal models. This review presents how camel milk as a superfood can be effective on diabetes by scientific documentaries.

Keywords: Camel Milk; Diabetes; Insulin-Like Protein

Introduction

After cow, buffalo, goat and sheep, camels are the fifth largest dairy animals globally, producing approximately 2.91 million tons of milk per year, equivalent to 0.36% of the world's milk production [1]. Diabetes is a group of metabolic disorders associated with chronic hyperglycemia in the blood due to a defect in insulin secretion, insulin function, or both [2]. Type 1 diabetes is a severe disease with many complications increasing worldwide. Three-quarters of the world's population cannot use allopathic medicines and therefore rely on drugs made from natural products of animals and plants [3]. Recently, it has focused on natural foods and traditional medicine. The best treatment for type 1 diabetes is insulin, which must be resistant to enzymatic degradation and easily absorbed. Still, insulin coagulates in the stomach and loses its effect in lowering blood sugar, and of course, it is expensive [2].

In addition to drugs used to treat diabetes, camel's milk is commonly used as an alternative treatment in Africa, Asia, and the Middle East. According to research, although the primary treatment for type 1 diabetes is insulin, camel's milk plays a vital role in maintaining the pancreatic beta cell's function, as well as improving kidney and liver function during diabetes and improving the lipid metabolism associated with type 1 diabetes [2].

Camel milk may prepare about 60% of the insulin in diabetic patients [3]. Raw camel milk has immune-modulatory effects on beta-cells of the pancreas, increases insulin secretion, reduces required insulin and insulin resistance, and improves glycemic control in type 1 diabetes patients [4,5]. Camel milk improves the diabetes complications such as obesity, inflammation, wounds, and oxidative stress damages [3].

Camel milk composition

The average fat content of camel milk was 3.82%, protein 3.35%, and lactose 4.12%. Also, in another study, the chemical composition of camel milk, including 3.4% protein, 3.5% fat, 4.4% lactose, 0.79% ash, 7.9% total solids, and 87% water, was reported [6]. The average fat is 1.2 and 6.4%, and the amount of short-chain fatty acids is low. Still, long-chain fatty acids, linoleic acid, and unsaturated fatty acids, which are essential for nutrition and health, are high [7].

| | Water | Protein | Fat | Ash | Lactose |
|---------|-------|---------|---------|---------|---------|
| Camel | 86-88 | 3-3.9 | 2.9-5.4 | 0.6-1 | 3.5-5.8 |
| Cow | 85-87 | 3.2-3.8 | 3.7-4.4 | 0.7-0.8 | 4.8-4.9 |
| Buffalo | 82-84 | 3.3-3.6 | 7-11.5 | 0.8-0.9 | 4.5-5 |
| Sheep | 79-82 | 5.6-6.7 | 6.9-8.6 | 0.9-1 | 4.3-4.8 |
| Goat | 87-88 | 2.9-3.7 | 4-4.5 | 0.8-0.9 | 3.6-4.2 |
| Human | 88-89 | 1.1-1.3 | 3.3-4.7 | 0.2-0.3 | 6.8-7 |

Table 1: Approximate chemical composition (%) of camel milk compared to other species milk. Adapted from Panwar, et al [8].

Camel milk immunoglobulins are high, and immunoglobulin G is the most abundant or dominant in camel milk [9]. In camel milk, the size of immunoglobulins is ten times smaller than human antibodies; This feature allows these antibodies to be more easily absorbed from the intestine and transferred into the bloodstream and shows antiviral, antibacterial, and immunological effects [10].

Zinc and magnesium levels in camel milk are higher than in cow and human milk. Camel milk is a good source of iron and can support rapid growth in infants and prevent iron-induced anemia [9]. It also plays an essential role in biological systems, including oxygen transfer and storage and DNA synthesis. The amounts of iron, copper, zinc, and manganese in camel milk are higher than in cow's milk [2,11].

Compared to the amount of vitamin C in the milk of other species, camel milk contains 52 mg of vitamin C per liter, compared to 27, 22, 29, 16, 35, 49, and 61 mg/l for cow, buffalo, sheep, goat, humans, donkeys, and mares, respectively [2]. Camel milk has little or no allergenicity due to a lack of beta-lactoglobulin and a low beta-casein as allergenic proteins. Higher concentrations of lactoferrin and lysozyme in camel's milk and high lactoperoxidase, immunoglobulin G, and vitamin C lead to higher antibacterial and antiviral properties than cow's milk [4]. Also, antimicrobial effects related to higher concentrations of lactoferrin in camel milk (220 mg/l) than cow's milk (110 mg/l) and lysozyme in camel milk (288 mg/100 ml) than cow's milk (13 mg/100 ml) [3].

Camel milk and diabetes

Diabetes mellitus is one of the most common metabolic disorders linked with cardiovascular diseases and kidney and liver failures [12]. Camel milk contains insulin-like proteins, which do not form coagulum in the acidic media of the stomach that can be an effective alternative for insulin [13]. In India, the incidence risk of diabetes in people who use camel milk regularly is much lower than others who don't use camel milk. Camel milk improves glycemic control and decreases insulin resistance in diabetes patients [14]. There is a high

amount of insulin in camel milk (about 52 units. Liter-1). Using camel milk in diabetes patients causes reduced in blood sugar and insulin requirements [15]. Camel milk improves obesity, inflammation, wounds, and oxidative stress damages as diabetes complications [16]. Therefore, the camel milk and its active compounds influence pancreatic, β -cells, and insulin receptors function in the insulin-sensitive, thus increasing insulin secretion [17].

How camel milk is effective on diabetes?

The effects of camel milk on diabetes were included: effect on insulin synthesis and secretion and insulin receptor function. Also, direct effects on insulin receptor function and glucose transport in the insulin-sensitive tissues, natural and indirect impact on insulin secretion by the pancreatic b-cells, and the regular activity of the pancreatic b-cells (Figure 1) [17]. Insulin-like proteins (52 units/liter) of camel milk are related to the lactation period and the storage condition that transfers to the circulatory system. In addition, insulin-like protein in camel milk was three times more than in cow milk [18].

The bioactive proteins of camel milk are effective by direct or indirect action on specific pathways controlling insulin synthesis and secretion by the pancreatic b-cells (Figure 1). Many hormones like glucagon and glucose-dependent insulinotropic polypeptides, such as gastric inhibitory polypeptide (GIP) and glucagon-like peptide-1 (GLP-1), as well as enzymes such as the endoprotease dipeptidyl peptidase IV (DPP-IV) and its proteolytic effects on GIP and GLP-1, have a crucial role in the control of insulin synthesis and secretion by the pancreas [17]. Finally, the indirect effects of camel milk may be known by its anti-inflammatory, anti-apoptotic, and antioxidant properties, which improve the secretory activity and overall function of pancreatic beta cells. The non-coagulation of camel milk in the stomach and the protective effects of small immunoglobulins of camel milk on pancreatic beta cells have also been suggested to explain the hypoglycemic effects of camel milk [17,19].

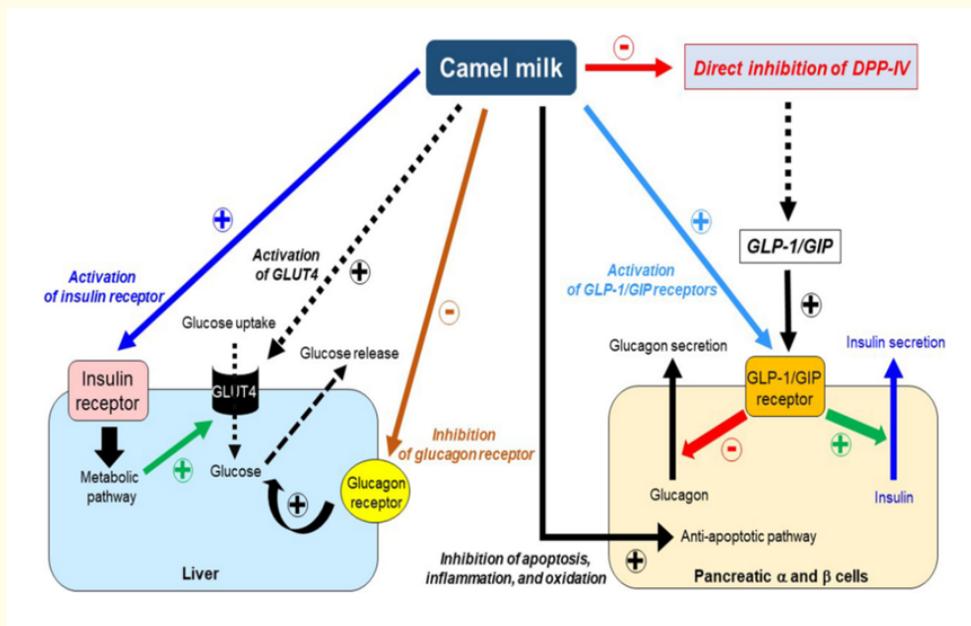


Figure 1: Different mechanisms of anti-diabetic effects of camel milk. Adapted from Ayoub et al. (17).

Among whey proteins, iron-binding glycoproteins of camel milk (lactoferrin) have an essential role on insulin function and signaling of insulin receptors and insulin resistance that influence diabetes disorders such as inflammation and obesity; In addition, lactoferrin has a direct effect on the insulin receptor of fat cells. It is not clear that camel milk lactoferrin bind to the insulin receptor and regulates its function and signaling [17].

A review of studies on the anti-diabetic properties of camel milk

In one experiment, diabetics cases, the same age (10 people per treatment) were given 500 ml camel milk daily in the morning and evening for two months, during which time the patients did not drink any other milk. After milking, camel's milk and cow's milk were first pasteurized at 70 degrees for 15 minutes and stored in the refrigerator. After two months, the results showed that camel milk reduced insulin requirements in diabetic patients [20].

The other researchers found that consuming 500 ml of camel milk daily reduced glucose and required insulin dose by 30 to 35%, But it does not affect the concentration of blood lipids. In addition, the anti-diabetic activity of camel milk may be due to its immune functions of pancreatic beta cells, anti-inflammatory effects, and antioxidants, which cause extensive changes in blood lipids and pressure and reduce the risk of cardiovascular disease [21].

Twenty-one patients with type 1 diabetes consumed 500 ml camel milk daily for six months in one experiment. Lipids factors such as LDL and triglycerides and the required insulin dose and albuminuria were reduced. Urine albumin level before treatment with camel milk was about 93.5 units per kilogram, and after treatment was approximately 60.64 units per kilogram. However, the required insulin amount before treatment with camel milk was 41.6 units per day and after treatment with camel milk reached 28.32 units per day [22].

In one study, the effect of camel milk on the improvement of type 1 diabetes was evaluated. In India, there is a traditional belief about camel milk in the treatment of diabetes; daily consumption can reduce the need for insulin in type 1 diabetes. The incidence of diabetes is low in the Raika population in Rajasthan, India, who regularly consume camel's milk. In this case, 54 diabetic patients aged 17 to 22 years were selected, and the first group took insulin according to their routine. Group 2 consumed 500 ml of camel milk daily for 68 weeks, and some were considered healthy controls [13].

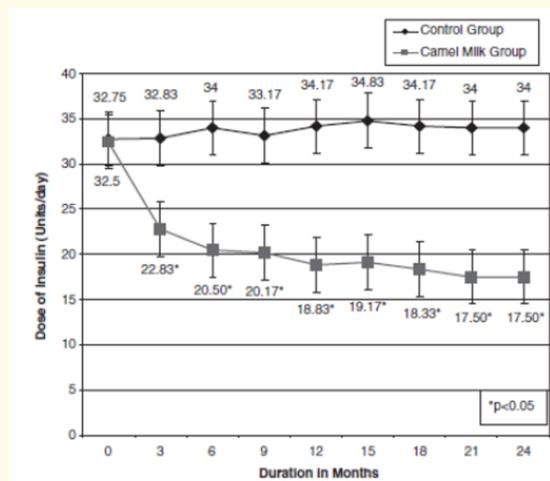


Figure 2: Average of required insulin dose in the control group and the group receiving camel milk over two years. Adapted from Agrawal, et al [4].

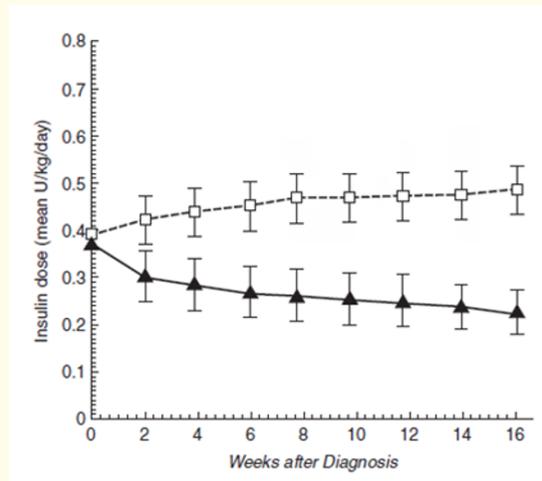


Figure 3: Mean dose of insulin required in the control group and the group receiving camel milk over 16 weeks. Adapted from Agrawal, et al [16].

The effects of camel milk on risk factors and blood sugar control in type 1 diabetic cases were investigated. In this experiment, 500 ml raw camel milk was used for three months in type 1 diabetic patients, which reduced blood sugar from 115 to 100 and the required insulin from 41 to 30 units per day. LDL also decreased significantly from 92 to 72, and total cholesterol and triglycerides reduced insignificant [15].

The following study investigated the effect of camel milk on blood sugar control and lipid profile of type 2 diabetic patients. In this experiment, 20 patients with type 2 diabetes were considered in two groups. One group was fed daily raw camel milk for three months, and one group was fed sterilized cow milk. Patients did not consume any other dairy during these three months [23].

The effects of raw camel milk on type 1 diabetes in Sudan were also evaluated. In this experiment, two groups of 15 people aged 18 to 19 years and between 2 and 15 years old with diabetes consumed 500 ml camel milk in the morning and evening for a year under similar conditions. Their blood conditions were checked every day for two months. The raw camel milk was collected weekly and stored in the refrigerator [24].

Glycosylated hemoglobin formation occurs by binding glucose to the terminal amino acid of valine in the beta-hemoglobin chain and is used as a factor in estimating blood glucose and the degree of diabetes control; because its amount in the blood increases in uncontrolled diabetes. Destroying pancreatic beta cells leads to inhibition of insulin secretion, increased blood glucose levels, increased production of triglycerides, LDL, and decreased HDL and uric acid [25].

For two years, this study evaluated camel milk's efficacy, safety, and acceptance as adjunctive insulin therapy in type 1 diabetes patients. Twenty-four patients with type 1 diabetes were divided into two groups. The first group (12 patients) received routine care, i.e. diet, exercise, and insulin; the second group (12 patients) received 500 ml camel milk and common or usual care. In the camel milk group, mean blood glucose, hemoglobin A1c, and insulin dose decreased. Insulin requirements in 3 people were also reduced to zero [4].

The effectiveness of camel milk as a drug treatment in young type 1 diabetes patients was evaluated for 16 weeks. Fifty-four type 1 diabetic patients (mean age 20 years) were divided into two groups of 27 members. The first group (control) was under regular treat-

ment (diet, exercise, and insulin), and the second group, in addition to conventional therapy, were treated with 500 ml camel milk. After 16 weeks, they observed a significant difference between the control group and the camel milk group [13].

Conclusion

In most of the clinical trials, the favorable effects of raw camel milk on diabetes observed which also improve risk factors such as liver and kidney failures and cardiovascular challenge derived from diabetes mellitus. Although it has been proved that camel milk is safe and effective superfood for improving long-term glycemic in human patients. But it appears that more scientific studies are needed to confirm the effectiveness of processed and camel milk powder on diabetes cases.

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