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Camel Milk as Adjuvant to Treat Alloxan Diabetes: Effect of Heat Treatment on this Property

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Abstract

Diabetes is one of the most frequent and serious chronic diseases in humans all over the world. The aim of our study was to evaluate the effect of heat treatment on antidiabetic activity of camel milk on serum glucose and lipid profile of alloxan-induced diabetic rats. Diabetes was induced in Wistar albino rats by intraperitoneal injection of alloxan (120 mg/kg BW once). Albino rats each weighing 180-230g were divided into 3 equal groups (n=4) as following: G1- normal rats fed on normal diet, G2 - diabetic rats fed on normal diet, and G3 - diabetic rats were fed with raw camel milk. Fasting blood glucose was measured lipid profile was assessed. Results: Our study showed a significant effect of raw camel milk on blood glucose and lipid profile parameters in alloxan induced diabetic rats, there was a significant reduction in lipid profile of T. Cholesterol, Triglycerides, LDL-C in (Diabetic+ Raw camel milk) comparing to (Diabetic+ Pasteurized camel milk) and Positive control group with values 121.4 mg/dl, 80.4 mg/dl, 17.9 mg/dl and 141.5 mg/dl, 90.7 mg/dl, 28.7 mg/dl and 181.6 mg/dl, 113.8 mg/dl, 48.9 mg/dl respectively. Diabetic+ Boiled camel milk group died at the end of experiment. Conclusion: Raw camel milk improved the glycemic and lipid profile in diabetic rats but not in Diabetic+ Boiled camel milk group. These findings indicate that boiling of raw camel milk may have reducing potential benefits in the treatment of diabetes. Future studies will be needed to establish its safety and mechanism of action.

Keywords: Diabetes; Alloxan; Pasteurized; Hyperglycemia.

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1. Introduction

Diabetes mellitus (DM) is a metabolic disorder characterized by the presence of chronic hyperglycemia that follows a defect in insulin secretion, insulin action, or both - either immune-mediated (type 1 diabetes) or resulting from a combination of insulin deficiency and insulin resistance (type 2 diabetes) [1]. Several pathological processes are implicated in the onset and development of diabetes ranging from the autoimmune destruction of beta cells of the pancreas to the insulin resistance associated with obesity [2].

All forms of diabetes are characterized by more or less absolute or relative deficits in insulin secretion, or insulin resistance associated with chronic hyperglycemia and a disturbance in the metabolism of carbohydrates, lipids and proteins. Insulin resistance is characterized by a decrease in insulin sensitivity of the whole body, muscle, liver and adipose tissue. Over time, high blood glucose causes chronic complications affecting various organs and tissues: diabetic retinopathy, nephropathy, neuropathy, macrovascular disease, etc. [3].

Insulin deficiency in diabetes mellitus causes lipolysis in adipose tissue and lipoprotein lipase deficiency, resulting in hyperlipidemia and fatty liver disease. Thus, in diabetes, hypercholesterolemia and hypertriglyceridemia often occur [4]. Alloxan (2,4,5,6- tetraoxypyrimidine; 2,4,5,6-pyrimidinetetrone) selectively destroys beta cells in the pancreas if injected in many animal species. This causes "Alloxan Diabetes", a form of insulin-dependent diabetes mellitus similar to type 1 diabetes [5]. Alloxan is the most common chemical compound used to induce experimental diabetes due to its selective destruction of beta cells in the pancreatic islets through sequential changes leading ultimately to apoptosis [6].

Camel milk is different from other ruminant's milk - low in cholesterol and sugar, but with a higher content of minerals (sodium, potassium, iron, copper, zinc and magnesium) and vitamin C. It is a potential remedy, with anti-hypertensive, anti-diabetic and ant carcinogenic properties [7]

2. Materials and Methods

2.1 Materials and methods

Camel milk samples: Every other day milk samples were collected early in the morning from a camel herd in United Arab Emirates. The samples were collected in sterile screw bottles and kept in cool boxes until transported to the laboratory at Dubai Institute for Environmental Research and Medical Analysis. Chemicals: Alloxan monohydrate (10 g) was purchased from Sigma ® Chemical Company (St Louis Mo, USA).

2.2 Experimental animals

20 healthy Wistar Albino rats of both sexes between 3 and 4 months of age and weighing between 120-250g were used for the study. The rats were procured from the animal house of Dubai Institute for Environmental Research and Medical Analysis, UAE.

2.3 Induction of experimental diabetes

The animals were housed individually in large, spacious, hygienic stainless steel cages during the course of the experimental period under standard conditions (house was well ventilated and animals had 12 ± 1 hour's day and night schedule; at room temperature 25 ± 5°C; 40– 60% relative humidity).

The animals were fed with standard rat pellet diet and water ad libitum during the experimental period. Diabetes was induced in Wistar rats by a single intraperitoneal injection of alloxan monohydrate in sterile normal saline to overnight fasted animals at a dose of 120 mg/kg body weight (BW). Four days after alloxan injection, diabetes was confirmed by measurement of blood glucose from tail vein blood using a Glucometer. Rats with fasting glycaemia > 180 mg/dl were considered diabetic and selected for the experiment.

2.4 Experimental design:

Group (G1) – healthy control rats (negative control group); Group (G2) - diabetic rats fed a normal diet (positive control group); Group (G3) - diabetic rats fed with raw camel milk and Group (G4) diabetic rats fed with raw camel milk after boiling for 65 ^{0}C; Group (G5) diabetic rats fed with raw camel milk after boiling for 100 ^{0}C using a feeding bottle instead of water, whereas animals in Group 1 and 2 were given tap water.

The diabetic animals were allowed free access to pellet diet, and were maintained at room temperature in large, spacious, hygienic cages. Baseline (t = 0) blood samples were taken to measure fasting blood glucose (FBG) before intraperitoneal injection of alloxan. Blood samples were drawn from the tail vein of each rat and the fasting blood glucose determination was done using a Glucometer. Blood was collected for the analysis of total cholesterol (TC), triglyceride (TG), high and low density lipoprotein (HDL and LDL).

Table 1: Experimental groups design

Group 1	Negative Control, control Rats
Group 2	Positive Control, diabetic rats
Group 3	Diabetic rats fed with raw Camel milk
Group 4	Diabetic rats fed with pasteurized Camel milk (65 ^{0}C for 30 mints)
Group 5	Diabetic rats fed with boiled Camel milk (100 ^{0}C for 3 mints)

3. Statistical analysis

A computer software package (SPSS), version 16.0 was used in the analysis. For quantitative variables, mean and standard deviation. Frequency and percentage are presented for qualitative variables.

Significance level (p) value was expressed as follows: $p > 0.05$ = Insignificant, $p < 0.05$ = Significant and $p < 0.001$ = highly significance. One- way ANOVA test was used for comparing between different groups.

4. Results and discussion

Table 2: Serum glucose levels (mg/dL) in apparently healthy, diabetic and camel milk treated rats.

	G1 (negative control)	G2 (Positive control)	G3 (Diabetic + Raw camel milk)	G4 (Diabetic + Pasteurized camel milk)	G5 (Diabetic + Boiled camel milk)
Day 1	95 mg/dl	297 mg/dl	506 mg/dl	430 mg/dl	461 mg/dl
Day 3	97 mg/dl	300 mg/dl	356 mg/dl	426 mg/dl	460 mg/dl
Day 7	98 mg/dl	277 mg/dl	158 mg/dl	360 mg/dl	399 mg/dl
Day 10	90 mg/dl	250 mg/dl	154 mg/dl	256 mg/dl	398 mg/dl
Day 12	96 mg/dl	259 mg/dl	148 mg/dl	221 mg/dl	398 mg/dl
Day 13	99 mg/dl	289 mg/dl	141 mg/dl	198 mg/dl	Died
Mean ± Sd	95.83 ± 6.40	278.6 ± 7.75	243.8 ± 3.22	315.16 ± 4.70	423.2 ± 10.5
P value < 0.05					

P value < 0.05 is significant, P > 0.05 non-significant

Table 3: Effect of feeding camel milk on lipid profile parameters

Groups	Total Cholesterol mg/dl	Tri-glycerides mg/dl	HDL-Cholesterol mg/dl	LDL-Cholesterol mg/dl
Negative control	90.5 mg/dl	70.60 mg/dl	36.4 mg/dl	15.7 mg/dl
Positive control	181.6 mg/dl	113.8 mg/dl	26.8 mg/dl	48.9 mg/dl
Diabetic+ Raw camel milk	121.4 mg/dl	80.4 mg/dl	34.5 mg/dl	17.9 mg/dl
Diabetic+ Pasteurized camel milk	141.5 mg/dl	90.7 mg/dl	31.6 mg/dl	28.7 mg/dl
Diabetic+ Boiled camel milk	At the end day of the experiment all animals died			

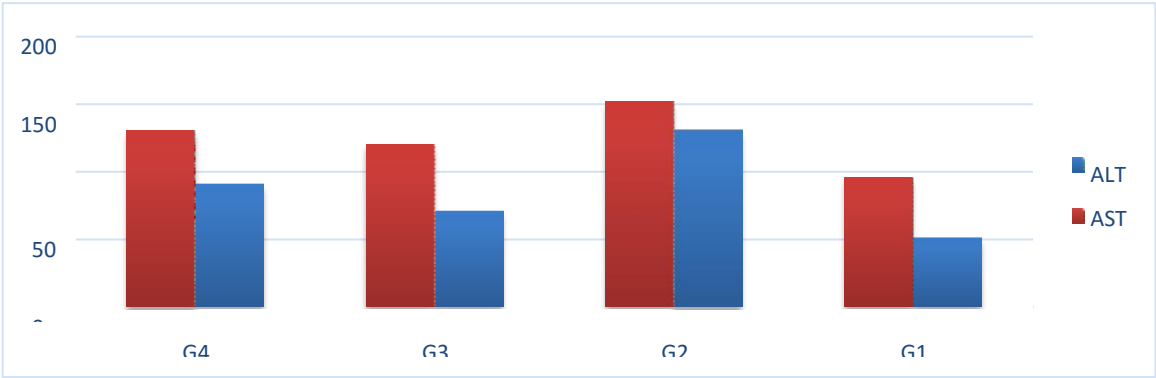

Figure 1: Liver enzymes in all groups.

Table 4: Insulin Like Peptide concentration in Raw, Pasteurized ad boiled camel milk

Camel type	Insulin Concentration
Raw camel milk	22 IU/L
Pasteurized camel milk	10 IU/L
Boiled camel milk	15 IU /L

Our study showed a significant effect of raw camel milk on blood glucose and lipid profile parameters in alloxan induced diabetic rats, there was a significant reduction in lipid profile of T. Cholesterol, Triglycerides, LDL-C in (Diabetic+ Raw camel milk) comparing to (Diabetic+ Pasteurized camel milk) and Positive control group with values 121.4 mg/dl, 80.4 mg/dl, 17.9 mg/dl and 141.5 mg/dl, 90.7 mg/dl, 28.7 mg/dl and 181.6 mg/dl, 113.8 mg/dl, 48.9 mg/dl respectively, our study results showed that there was increasing in HDL-Cholesterol in (Diabetic+ Raw camel milk) comparing to (Diabetic+ Pasteurized camel milk) and Positive control group with values 17.9 mg/dl, 28.7 mg/dl and 26.8 mg/dl respectively this is in agreement with the results of Manal and his colleagues [8]. The hypoglycemic effect of camel milk could be probably due to the high levels of insulin or insulin-like proteins in camel milk. These results are in agreement with those of Agarwal and his colleagues who used a radioimmunoassay to measure insulin in camel milk and revealed that it contains a high concentration of insulin at 52.03 U/l [9]. It has been reported that camel milk contains high levels of vitamins A, B2, C and E and high mineral content (sodium, potassium, iron, zinc, copper and magnesium). These vitamins play the role of antioxidants, thus eliminating free radicals, useful in the prevention of tissue damage caused by toxic agents [10]. Vitamin C has been found to play a significant role in decreasing the high levels of blood hydroperoxide, glucose, cholesterol, triglycerides and low- density lipoprotein (LDL) in diabetic rats [11]. Our study showed a significant effect of raw camel milk on serum creatinine comparing to (Diabetic+ Pasteurized camel milk) and Positive control with values 1.6 mg/dl, 2.1 mg/dl and 3.5 mg/dl

5. Conclusions

Our study indicated the positive effect of raw camel milk on blood glucose and lipid profile in alloxan induced diabetic Albino rats comparing with Pasteurized and Boiled camel milk. This suggests that camel milk could be used in the treatment of diabetes in humans and may be helpful in controlling diabetes. However, more studies are needed to assess its safety, as well as its mechanism of action.

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