HYPOGLYCEMIC ACTIVITY OF CAMEL MILK IN CHEMICALLY PANCREATECTOMIZED RATS – AN EXPERIMENTAL STUDY

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ABSTRACT

In our earlier study, we demonstrated hypoglycemic activity of camel milk in diabetic rats. In continuation of that study, a further study was planned to know whether raw camel milk, pasteurized camel milk and lectoferrin added camel milk have similar response or different response in chemically pancreatectomized rats. 32 Male albino rats were rendered diabetic by a single intra peritoneal injection of streptozotocin 50mg/kg body weight. Streptozotocin induced diabetic rats were randomized to receive either raw camel milk, pasteurized camel milk, raw camel milk + lactoferrin, or cattle milk and control [non diabetic rats (n=8)] which were followed for 4 weeks. Blood glucose levels of these rats were estimated at weekly interval for four consecutive weeks. Statistical significance was tested by ANOVA with post hoc comparison between group means.

Initial mean blood glucose levels of different groups i.e. Gp.I, Gp.II, Gp.III, Gp.IV and Gp.V were 169.68±28.73, 135.44±20.91, 175.04±35.98, 168.38±18.67 and 85.94±9.37 mg/dl, respectively. After four weeks of trial, mean blood glucose levels of these groups were 81.54±11.43, 113±29.09, 93.24±11.56, 203.79±40.66 and 77.28±7.41 mg/dl, respectively. There was significant difference with raw camel milk (mean difference 88.14±17.3, $p<0.02$), this difference is decreased after pasteurization (mean difference 22.4±8.18, p 0.5) and there was no added advantage after adding lactoferrin (mean difference 81.8±24.42, $p<0.05$).

The present study indicates that there was significant decrease in mean blood sugar level in diabetic rats getting raw camel milk. There were no added advantages of adding lactoferrin in raw camel milk. Hypoglycemic activity of camel milk decreases after pasteurization. Camel milk may be a therapeutic adjunctive option for diabetes mellitus in humans.

KEY WORDS: Camel Milk; Pasteurization; Lectoferrin; Experimental diabetes; Streptozotocin rats.

INTRODUCTION

In an earlier animal study it was shown that camel milk has hypoglycemic activity (1) but we are still not sure how it is helpful. Hence we planned to see the effect of lactoferrin (rich protein in camel milk) supplemented camel milk and pasteurized camel milk versus ordinary camel milk on hypoglycemic activity in streptozotocin induced diabetic rats. Lactoferrin, an iron containing milk protein, acts as a probiotic having physiological activity in gastrointestinal tract. Camel milk has been reported to have a higher antimicrobial activity compared to bovine milk. This is partially due to higher concentration of lactoferrin in its milk (220 mg/l) compared to bovine milk (110 mg/L) (2). In clinical trials, 30-35 percent reduction in doses of daily insulin in patients of type 1 diabetes receiving camel milk was reported (3, 4). The camel milk is different from other ruminant milk; having low cholesterol, low glucose, high mineral (sodium, potassium, iron, copper, zinc and magnesium), high vitamin C (5) and large concentrations of insulin (6). The value of camel milk is to be found in the high concentrations of volatile acids especially, linoleic acid and polyunsaturated acids, which are essential for human nutrition (7). In the present study emphasis has been placed on the effect of camel milk as raw and pasteurized, to see the oral hypoglycemic activity of camel milk in streptozotocin induced diabetic rats, with the aim that such an investigation would help to establish a more rational use of camel milk to control blood glucose level.

MATERIALS AND METHODS

Forty white albino rats of approximately same age group (8 weeks old, male) having body weight (~150gm) were acclimatized under laboratory

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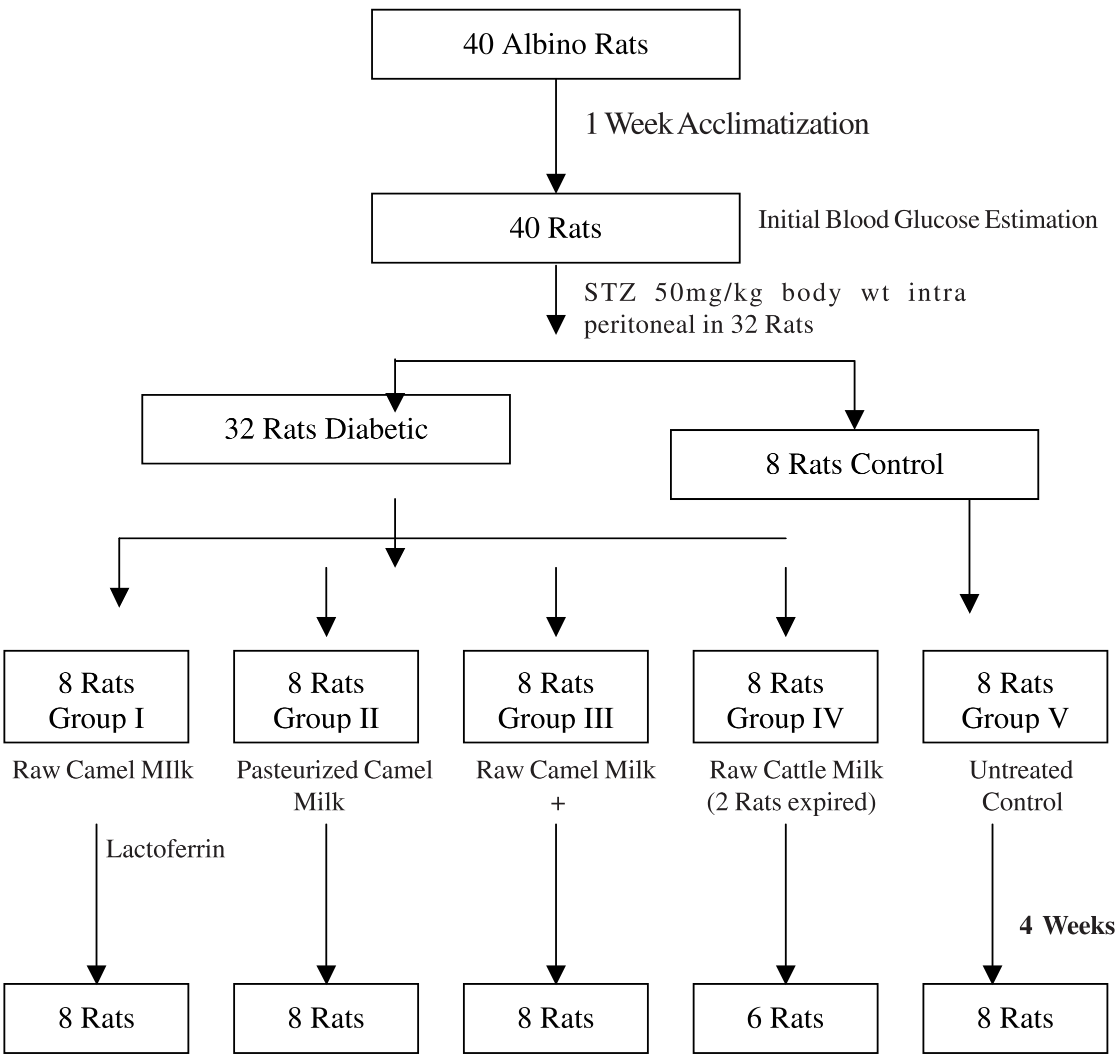
conditions for a week by keeping them on standard rat chow and water ad libitum. Animals were housed in a temperature, humidity and light controlled room (temperature 22±0.5°C, humidity 50%, 12h light, and 12h darkness). All experimental procedures were approved by the ethical committee of National Research Center on camel. Their fasting blood glucose level following overnight food deprivation but allowing free access to water, was estimated. Then these rats were divided into five groups (Gp.I, Gp.II, Gp.III, Gp.IV and Gp.V) of 8 rats each. Diabetes was induced in rats of Gp.I, Gp.II, Gp.III and Gp.IV by single intra peritoneal administration of Streptozotocin (50 mg/kg). [(Sigma chemical) dissolved in 1ml sodium citrate buffer at 4°C. Streptozotocin causes β cell necrosis and diabetes develops in 1-2 days. At doses of 50mg/kg, severe ketosis does not develop and rats survive for some weeks without insulin replacement. Rats in Gp. V were kept as untreated controls. Rats were considered diabetic if they were positive for glycosuria on 2 consecutive days and the fasting plasma glucose concentration was greater than 126 mg/dl. Rats of Gp.I to Gp.IV were given 25 ml of camel milk daily by watering bottle instead of water. Gp II was given 25ml of pasteurized camel milk daily. In Gp.III, 1mg of lactoferrin separated from camel milk was additionally added to raw camel milk. In Gp.IV rats were given 25ml of cattle milk. Animals in Gp.V were given tap water. Pasteurization of milk was done at 63°C for 30 minutes. The blood glucose level of all these groups was estimated at weekly interval for four consecutive weeks. Blood samples were drawn from cardiac puncture using tuberculin syringe from overnight fasted rats.

Serum samples were harvested and glucose level was determined spectrophotometrically employing glucose oxidase method. (Fig-1)

Fig 1: Study Plan and Protocol.



After inducing diabetes, the rats were randomly allocated into four groups and treated for 4 weeks as follows: group I rats were fed with standard rat chow with raw camel milk, group II rats were fed with standard diet and pasteurized camel milk, group III rats were fed with standard diet + raw camel milk + lactoferrin, group IV rats were fed with standard diet and cattle milk and group V rats were only on standard normal diet.

Data were expressed as mean ±SE. Statistical significance was tested by ANOVA with post hoc comparison between group means. A p value <0.05 was considered statistically significant.

RESULTS

Chemically pancreatectomized rats had lower body weights than control rats at the end of experiments. After 4 weeks trial of raw camel milk in group I blood sugar came down from 169.69±28.73 to 81.54±11.43 (mean difference 88.15±17.3, $p<0.02$) (Fig-2a). In group II when pasteurized camel milk was given there was slight decrease from 135.45±20.91 to 113.08±29.09 (mean difference 22.37±8.18, p = NS) (Fig-2b). When lactoferrin was added with raw camel milk there was more or less similar response as group 1 i.e. from 175.05±35.98 to 93.24±11.57 (mean difference 81.81±54.41, $p<0.05$) (Fig-2c). When cattle milk was added there was no response and two rats developed severe diabetes and could not continue. In remaining 6 rats the mean glucose went up from 168.38±18.67 to 203.79±40.66 (Fig-2d). In control group, there was no change as such. In the beginning the mean blood glucose was 85.94±9.37 and at the end of the 4 weeks it was 77.29±7.42 (Fig-2e) (Table 1).

Fig 2: Effect of Different Treatment Regimens on Blood Glucose in Diabetic Rats and Controls.

Fig 2a

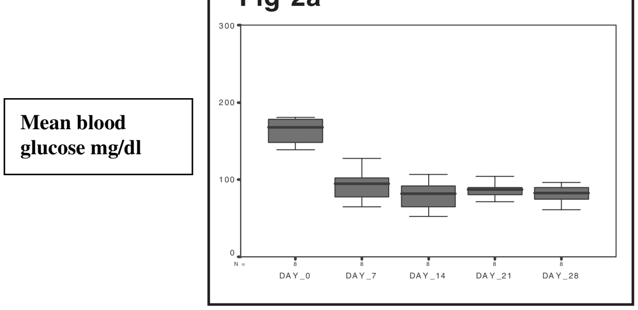


Fig 2b

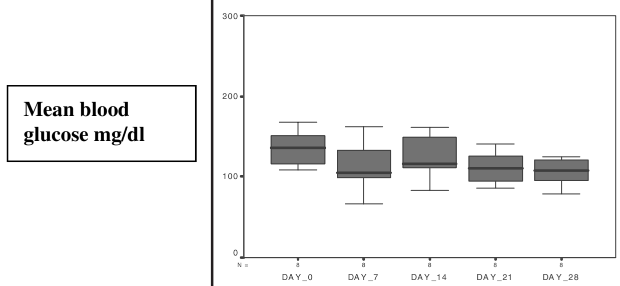


Fig 2c

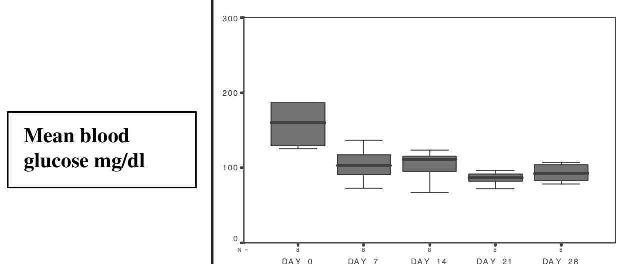


Fig 2d

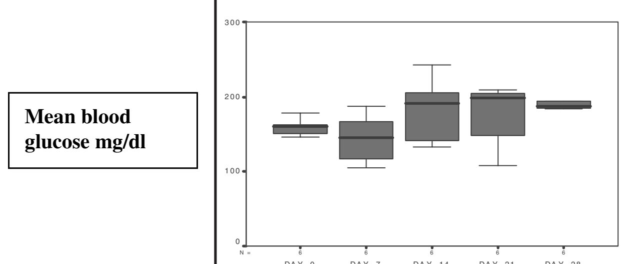


Fig 2e

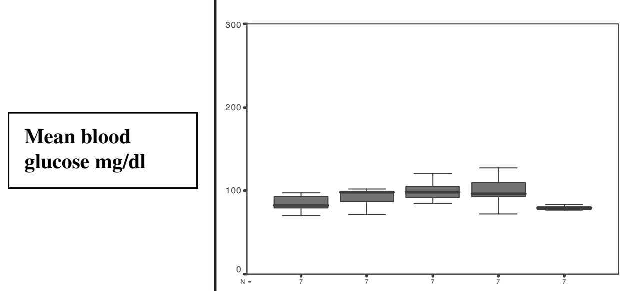


Table 1: Effect of Different Treatment Regimens on Blood Glucose in Diabetic Rats and Controls

Mean blood glucose level (mg/dl)	Gp.I Raw camel milk	Gp.II Pasteurized camel milk	Gp.III Raw camel milk + Lactoferrin	Gp.IV Raw cattle milk	Gp.V Untreated control
Baseline	84.69±8.14	84.76±8.15	83.98±21.90	84.98±15.69	77.10±13.30
Day 0	169.69±28.73	135.45±20.91	175.05±65.98	168.38±18.67	85.94±9.37
Day 7	92.58±19.71	112.94±29.16	104.06±20.02	149.56±27.94	92.71±10.62
Day 14	79.28±18.77	124.95±25.91	104.63±18.18	202.31±60.87	96.82±14.16
Day 21	86.18±9.67	111.03±19.05	86.54±7.60	177.71±40.99	97.21±18.66
±Day 28	81.54±11.43	113.08±29.09	93.24±11.57	203.79±40.66	77.29±7.42
p value	<0.02	0.5	<0.05	0.5	0.5

DISCUSSION

The study was performed to observe the role of camel milk in achieving glycemic control in streptozotocin induced diabetic rats. It was observed that there was significant decrease in mean blood sugar level in rats getting raw camel milk. There was no added advantage of adding lactoferrin in raw camel milk. Hypoglycemic activity decreases after pasteurization. The hypoglycemic activity of camel milk may be because of high concentrations of insulin like protein in camel milk. While Yagil found a significant insulin content in camel milk and reported diabetic therapy with camel milk (8), Agrawal et al. (2003) (3, 4) reported average reduction of 30 percent in the daily doses of insulin in patients of type I diabetes receiving camel milk. It may be because of higher insulin/insulin like protein in camel milk. Camel milk contains 45-128 units/litre insulin (Singh, 2001) (6). Oral insulin has been known since many years but the main draw back appears to be its coagulum formation in acidic media in stomach, which neutralizes its potency. One property of camel milk is that it does not form a coagulum in stomach or in acidic media; thereby it prevents degradation of insulin in stomach.

Insulin like growth factor system in the bovine mammary gland has insulin receptors and binding proteins, concentrations of which change at different stages of lactation. Insulin like growth factor-I (IGF-I) levels were highest in colostrum compared to those in milk (10). The same comparison was noted in several species such as cow (11, 12) and humans (13, 14). Pasteurization of milk seems to lose this ability, so this factor appears to be heat labile one. High mineral content in camel milk (sodium, potassium, iron, zinc, copper and magnesium) as well as a high vitamin-C intake may act as antioxidant, thereby removing free radicals, which may provide a stress free situation to the animals. The vitamin C levels in camel milk are three times that of cow milk and one-and-a-half time that of human milk (7). High concentrations of antioxidants may make the insulin receptors to respond better to available insulin.

The belief among the Bedouins of the Sinai Peninsula is that drinking camel milk can cure any internal disease. The milk is said to be of such strength, and to have such health-giving properties, that all the bacteria are driven from the body. This action of camel milk may put less pressure on the immune system of the body, which in turn may improve other functions of the body. Unlike human immunoglobulin, which has a more complex structure, with two light chains bound to the heavier Y-shapped main chain, camel immunoglobulin has only the main Y-shaped heavy chain, without these additional parts (9). The camel's antibodies find it easier to penetrate enzyme active sites. This action of camel immunoglobulins present in milk, might offer a better action of other proteins like insulin.

In the present study adding lactoferrin to the raw camel milk in Gp.III did not reflect positive impact. Further studies are warranted to fractionate the active principal and to find out its exact mode of action. The data of this study shows a significant hypoglycemic effect of raw camel milk and this effect is decreased when camel milk is boiled. We also studied that insulin/insulin like activity decreases on boiling camel milk even on pasteurization. Hence, we are planning to sterilize camel milk through UV rays. No doubt camel milk has good bacterial and anti viral activity (16), thus if camel milk is used raw, there are less chances of transmission of infection. An epidemiological study of Raica Community revealed zero prevalence of diabetes in camel milk consuming Raica community vs. 3-4% prevalence of diabetes from other communities living in the same environment, having same life style except that they were not drinking camel milk (15).

In conclusion, this is the second study which has demonstrated the usefulness of camel milk in diabetic rats. This may have important implication for the clinical management of diabetes mellitus in humans. The food industry could design and construct functional foods with probiotics. These food products could be positioned between conventional foods and medicines, with their use targeting semi-healthy state of the body as a preventive measure against disease. This concept is consistent with the historic belief that natural substances play an important role in preventative and therapeutic treatment.

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