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Effect of Supplementation of Natural Honey on Serum Albumin and Total Protein of Alloxan Induced Diabetic Wister Rats

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Abstract

Background: Diabetes mellitus is a metabolic disorder that is associated with abnormalities in most biochemical markers including depletion of proteins as a result of its excessive catabolism and/or diminished synthesis. The present study is aimed at determining the changes that may occur in the levels of albumin and total proteins following 8-week supplementation of honey in diabetic rats.

Methods: 48 male Wister rats weighing 200-250 g separated into 6 groups of 8 rats each were used for the experiment; Groups 1 and 3 are non-diabetic and diabetic controls respectively. Group 2 is non-diabetic test group which received 10 ml/kg/day of 50% honey whereas groups 4, 5 and 6 are diabetic test groups which received 10 ml/kg/day of 10%, 30% and 50% honey respectively. Diabetes was induced in groups 3 to 6 by intraperitoneally injecting 2% alloxan solution as 200 mg/kg and confirmed with a blood sugar ≥ 12.0 mmol/l. The animals were sacrificed at the end of 8 weeks and blood samples collected to measure the levels of albumin and total protein.

Results: The results showed that 8-week honey supplementation significantly increased the serum concentrations of albumin in both diabetic and non-diabetic rats. There was however, no significant change in the levels of total protein in both diabetic and non-diabetic rats.

Conclusion: Our findings suggest that honey may have a possible anti-catabolic effect on albumin and may also protect the hepatocytes from the oxidative stress in diabetes with resultant improved synthesis of albumin.

Keywords: Honey; Albumin; Total protein; Diabetic rats

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Introduction

Diabetes mellitus remains incurable despite advances in medical science. The disease is known to cause derangements in the metabolism of carbohydrates, proteins and lipids due to insulin deficiency. This results in hyperglycemia, depletion of proteins and abnormal fat metabolism. The depletion of proteins may be due to either increased catabolism and/or decreased synthesis of proteins. In poorly controlled diabetes, the whole body protein flux is reported to be increased by 20-30% when compared to well-controlled type 1 diabetes mellitus and normal subjects [1]. The primary effect of insulin administration on proteins therefore

is to reduce the increased catabolic rate. Albumin is the most abundant plasma protein [2] and is involved in many physiological processes including maintenance of colloidal osmotic pressure, binding and transport of substances and acting as an amino acid source. Cessation of insulin treatment in diabetic rats leads to a significant reduction in the synthesis of albumin relative to total protein [3]. Albuminuria which is a feature of complicated diabetes may also result in low serum albumin [4]. Low albumin concentration increases the risk of both incident type 2 diabetes [5] and of complications in diabetics. Maintaining the serum concentration of albumin would therefore be a key factor in diabetic management. Therefore dietary supplementation

of any cheap and readily available product that is capable of preventing hepatic or renal damage needs be included in diabetic management. Although the health benefits of honey have been widely explored, its use in diabetic management is only scarcely reported. Honey contains at least 181 substances, predominantly fructose and glucose but also vitamins, amino acids and proteins. The aim of the present study is to determine the effect of honey on the serum concentrations of albumin and total protein in diabetic and non-diabetic rats.

Materials and Methods

This research was carried out in the animal house of the department of Human Physiology, University of Port Harcourt. 48 male wistar rats weighing 200 to 250 g were used for the experiment. The animals were separated into 6 different cages containing 8 rats each and acclimatized for two weeks prior to the experiment. Group 1 served as the non-diabetic control (NDC) and received 10 ml/kg/day of distilled water orally. Group 2 was also non-diabetic but received 10 ml/kg/day of 50% honey orally (NDH50%). Group 3 served as diabetic control (DC) and received 10 ml/kg/day of distilled water. Group 4 was diabetic and received 10 ml/kg/day of 10% honey (DH10%). Group 5 was diabetic and received 10 ml/kg/day of 30% honey (DH30%). Group 6 was diabetic and received 10 ml/kg/day of 50% honey (DH50%). Ethical approval was obtained from the College of Health Sciences ethics committee. The animals were handled according to institutional and national guidelines on animal experimentation. Diabetes mellitus was induced in the test groups by intra-peritoneal injection of 2% alloxan solution as 200 mg/kg following an overnight fast and confirmed after 72 hrs with a blood glucose level ≥ 12.0 mmol/l. The blood glucose levels were measured using ACCU-CHEK ACTIVE glucometer. Natural honey used for this research was purchased from 'divine honey' (a bee farm in Southern Nigeria) and reconstituted by diluting with distilled water to produce 10%, 30% and 50% honey respectively. The animals in the test groups received honey orally for a period of 8 weeks and thereafter sacrificed and blood samples taken to determine serum concentrations of total proteins and albumin. Serum albumin was measured using the bromocresol green dye binding method while serum total protein is measured by the Biuret method.

Results

Statistical analysis of data was done using SPSS vs.20.0. A table was used to represent data. Continuous variables were expressed as mean \pm standard error of mean. Comparison of means were done using one-way analysis of variance (ANOVA) test and differences in values considered statistically significant at $p < 0.05$.

Discussion

Daily supplementation of honey for 8 weeks caused a significant rise in the serum concentrations of albumin in both diabetic and non-diabetic rats compared to their respective controls (**Table 1**). However, there was no significant difference in the serum

Table 1 Serum concentrations of total protein and albumin in non-diabetic and diabetic rats fed with honey.

Group	Total Protein (g/dl)	Albumin (g/dl)
NDC	8.20 \pm 0.58	3.51 \pm 0.14
NDH50%	8.19 \pm 0.68	4.24 \pm 0.27*
DC	6.79 \pm 0.27	3.66 \pm 0.18
DH10%	6.16 \pm 0.38	4.91 \pm 0.23 [#]
DH30%	8.18 \pm 0.74	5.19 \pm 0.13 [#]
DH50%	6.35 \pm 0.46	5.42 \pm 0.14 [#]

levels of total protein for both non-diabetic and diabetic test groups. Albumin synthesis is physiologically stimulated by insulin [6] by modulating the amount of albumin mRNA [7]. Albumin competitively inhibits glycation of less abundant proteins [8] such that low levels of albumin would be associated with increased glycation of other plasma proteins such as HbA1C in diabetes. Glycation alters the structure and function of proteins. A rise in HbA1C indicates poorly controlled diabetes, therefore maintaining the serum albumin level is important in preventing early development of diabetic complications. The increased serum albumin shown in the present study may have resulted from either enhanced synthesis or decreased catabolism. This further would confirm the possible hepato-protective effect of honey [9,10]. Honey has been reported to cause regeneration of damaged cells [11]. So that reversal of damaged hepatic cells and/or prevention of damage to hepatic cells may have significantly improved albumin synthesis. The anti-catabolic effect of honey on the albumin levels of diabetic rats may be attributed to its hydrogen peroxide constituent that had been reported to mimic insulin [12]. This would enhance the uptake and utilization of glucose by cells and reduce gluconeogenesis, thus sparing the proteins (especially albumin). Low albumin levels may also cause a decline in the antioxidant activity of type 1 diabetic rats [13]. In the present study, the significant rise in albumin concentrations of honey treated diabetic rats may promote antioxidant activity [14] with resultant reduction in protein catabolism. Similar results of elevated serum albumin in response to honey supplementation had been reported in patients with AIDS [15]. Higher albumin level is associated with lower blood glucose [16,17]. Honey supplementation in diabetes may therefore be a necessary factor in the dietary management and could be useful clinically in glycemic control. By protecting the albumin levels, honey supplementation can therefore delay the development of diabetic complications.

Conclusion

The present study showed that 8-week supplementation of honey caused a significant increase in serum albumin levels in both diabetic and non-diabetic rats. However, there was no significant change in the levels of serum total protein in both diabetic and non-diabetic rats. Our findings suggest that honey may have a possible anti-catabolic effect on proteins (especially albumin) and may also protect the hepatocytes from the oxidative stress usually posed by diabetes with resultant improved synthesis of albumin. By protecting the albumin levels, honey supplementation may therefore delay the development of diabetic complications.

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