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Original Article

BLOOD GLUCOSE CONTROL AND BODY WEIGHT OF EXPERIMENTAL DIABETIC RATS CO-TREATED WITH MICRO NUTRIENTS

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ABSTRACT

Disturbance in blood glucose and fuel metabolism are hallmarks in diabetes mellitus, and antioxidants are believed to play a role in the control of this disturbances. In the current work, antioxidant such as manganese (10mg/kg/body weight), copper (2mg/kg/body weight) and zinc (15mg/kg/body weight) were supplemented in alloxan-induced diabetic rats for a period of 4 weeks. Initial and final Fasting Blood Glucose (FBG) of the rats was 77.29±8.65mg/dl and 75.00±7.22mg/dl in controls, 408.14±49.44mg/dl and 107.00±11.07mg/dl in diabetics treated not supplemented, and 448.14±43.18mg/dl and 83.14±5.45mg/dl in the diabetic treated and supplemented respectively. There was statistically significant difference in the final FBG concentration of supplemented and unsupplemented groups ($p<0.05$). Initial and final body weight was 155.14±4.25g and 157.57±4.16g in controls, 147.14±7.91g and 143.43±8.70g in diabetics treated not supplemented, and 159.86±13.15g and 184.71±11.50g in the diabetic treated and supplemented respectively. There was statistically significantly difference in the final body weight of supplemented and unsupplemented rats ($p<0.05$). In conclusion, supplementation with anticxidant micronutrients might improve blood glucose control and improve body wastages usually experienced in diabetics.

Key words: *Diabetes, Micro nutrients, Blood Glucose, Body Weight.*

INTRODUCTION

Requirement for micro nutrients is defined as an intake level which meets specific criteria for adequacy, thereby minimizing the risk of nutrient deficit, which is usually determined and measured through subclinical conditions, identified by specific biochemical makers. Biochemical assays have been the most relevant indices of measuring subclinical conditions relevant to vitamins and minerals intake[1]. In patient with diabetic mellitus, decreased levels of antioxidant micro nutrient have been reported[2]. It is logical therefore, that this decrease might negatively influenced the activities of major antioxidant defense enzymes in the body, which require these micro nutrients as their cofactors and co-enzymes, with resulting elevation of markers of lipid peroxidation. Dallatu *et al*[3] reported supplemented with antioxidant micronutrients, had improved the activities of some *denovo* antioxidant defence enzymes in alloxan-induced diabetic rats. Diabetics experienced a wide range abnormal fuel metabolism secondary to relative or complete absence of insulin. This trigger counter reactions and activities in which body fats and protein are mobilized to counter the effect of pseudohypoglycaemia. These result into polyphagia, polydipsia and polyuria, with attending nutrient lost and body wastages. Stephen[4] reported that dietary supplements can promote healthy blood glucose, healthy blood cholesterol, healthy immune system, and healthy digestive function and play a useful adjunctive role in the control of colorie intake. The purpose of the current research is therefore, to study the effect of supplementation with antioxidant micronutrient, on blood glucose homeostasis and body weight of alloxan-induced diabetic rats.

MATERIALS AND METHODS

Experimental Animals: Male albino wistar rats (120-180 g) were purchased from Animal House, Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Zaria. The animals were housed for a

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period of one week under similar conditions in standard cages at 25±2°C, with 12-hour light/dark cycle. The animals were maintained on poultry feed (Vital Feeds, Jos) *ad libitum*.

Chemicals: All the reagents used for the study were of analytical grade. Alloxan was purchased from Sigma Aldrich Chemical Co. (U.K), kits for the assay of serum glucose was purchase from Randox Laboratories. Micronutrients and normal saline were purchased from a reputable pharmacy in Zaria Town, Kaduna State, Nigeria.

Induction of Diabetes: Experimental diabetes was induced by a single intraperitonial injection of freshly dissolved Alloxan (150 mg/kg b.w) in normal saline maintained at 37°C, to rats fasted for 12 hours. Control rats received a similar volume of normal saline alone. After 72 hours of alloxan injection, the animals were fasted overnight and their fasting blood glucose were estimated using a commercial glucose kit. Only rats that had fasting blood glucose level of 126 mg/dl (> 7.00 mmol/l) and partial destruction of pancreas tested with positive response to metformin were included in the study.

Experimental Design: The rats were divided into 3 groups of 7 rats each:- Group 1.: (Control); Group 2. Diabetic + metformin (250 mg/kgbw) (D.T.N.S); Group 3. Diabetic + metformin (250 mg/kgbw) + copper (2 mg/kgbw) + manganese (10 mg/kgbw) + zinc (15mg/kgbw) (D.T.S.M). The supplementation lasted for one month and after the last day; the animals were fasted overnight and anaesthesized by dropping each in a transparent plastic jar saturated with chloroform vapour. Incision was made on the abdomen. Blood sample was collected through cardiac puncture and divided into plain and EDTA-containing centrifuge tubes. Humane procedure was adopted throughout the experiment.

Measurement of Biochemical Analytes: Blood glucose concentration was assayed as described by the method of Trinder[5]. 10µl of serum sample was mixed with 1ml of glucose oxidase reagent, and incubated as 37°C for 30 minutes. Absorbance was taken at 505nm. Digital bench weight balance was used to measure the weights.

Statistical Analysis: All data were expressed as the Mean ± Standard Error of Mean (S.E.M). Data were analyzed using Analysis of Variance (ANOVA) InStat3 Software. Differences in mean were considered to be significant from $p<0.05$.

RESULTS

The results of the current study were presented in Tables 1 and 2. Initial and final fasting blood glucose was 77.29±8.65mg/dl and 75.00±7.22mg/dl in control, 408.14±39.44mg/dl and 107.00±11.07mg/dl in diabetic treated non supplemented, and 448.14±43.18mg/dl and 84.14±5.45mg/dl in the diabetic group treated and supplemented. There was statistically significance difference in the final blood glucose level supplemented between result and unsupplemented groups ($p<0.05$). The initial and final body weight of the experimental animals was 155.14±4.25g and 157.57±4.169 in the controls, 147.14±7.91g and 143.43±8.70g in the diabetic group treated not supplemented, and 159.86±13.15g and 180.71±11.50g in the diabetics treated and supplemented. There was statistically significance difference between the final body weight of the supplemented and unsupplemented groups ($p<0.05$).

DISCUSSION

Dietary pattern changes overtime and these changes are dependent on such factors like agricultural practices, cultural and socioeconomic considerations. Medically, certain disease conditions necessitate alterations in life style, food intake and in certain circumstances, the need for supplementation to meet the basic health requirements as dictated by a particular disease condition[1].

In the present study, the effect of diabetes mellitus on blood glucose control and body wastage is highlighted, supplementation with antioxidant micronutrients, have positively influenced the blood glucose regulation and improved the body weight of the supplemented subjects. This is in agreement with the finding of Song *et al*[6] who reported a decrease in food and water intake, and subsequent reduction in body weight of streptozotocin-induced diabetic rats. Adeneye, *et al*[7] reported an improved lowering of blood glucose in alloxan-induced diabetic rats, treated with

metformin and supplemented with vitamin C. Mark and Ely[8] reported that appropriate micronutrient supplementation can improve glucose tolerance and reduce auto-oxidation.

El-Beshbishy[9] reported an increase in the body weight of experimental rats, after supplementation with extract of green tea, believed to be rich in antioxidant micronutrients. Lacey *et al*[10] reported that, ROS cause damage to lipid membrane, intracellular protein and DNA, and are believed to be efficient inducers of apoptosis. Jakus[11] reported that consequences of oxidative stress are damage to DNA, lipids, proteins, disruption of cellular homeostasis and accumulation of damaged molecules.

Trace elements are part of, and interact with enzymes and hormones that regulate the metabolism of large amount of substrate[12]. As such, deficiency must affect their metabolism including glucose. Oxidative damage to cell component is reported to be diverse, and the attack is non-specific[13]. This could be the basis of body wastage and reduction in weight observed in the current work.

It is generally recognized that, certain group of patients, including diabetics, are at risk of free radical initiated damage, and supplementation with antioxidant micronutrients might therefore, modify their antioxidant defenses, and minimize the potential danger associated with the result. We therefore, recommended the inclusion of antioxidant nutrients in the treatment of diabetics.

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Table 1 **Initial and Final Fasting Blood Glucose (mg/dl) [#] of Alloxan Induced Diabetic Rats Supplemented with Antioxidant Micronutrients**

Group	Initial FBC	Final FBC
Control (n=7)	77.29±8.65	75.00±7.22
Diabetic treated only (n=7)	408.14±39.44[*]	107.00±11.07[*]
Diabetic treated supplemented (n=7)	448.14±43.18[*]	83.14±5.45[**]

*±± Values are Mean, ± Standard Error of Mean of Alloxan -Induced Diabetic Rats Supplemented with Antioxidant Minerals for 28 days. * Values Differ Significantly From Controls. ** Values Differ Significantly From Unsupplemented.*

Table 2 **Initial and Final Body Weight (g)[#] of Alloxan Induced Diabetic Rats Supplemented with Antioxidant Micronutrients**

Group	Initial FBC	Final FBC
Control (n=7)	155.14±4.25	157.57±4.16
Diabetic treated only (n=7)	147.14±7.91	143.43±8.70[*]
Diabetic treated supplemented (n=7)	159.86±13.15	180.71±11.50[**]