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**NJBMB/018/11** **SHORT COMMUNICATION**

# Blood glucose and body weight control of diabetic rats co-treated with micronutrients

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ABSTRACT
Disturbance in blood glucose and fuel metabolism are hallmarks of diabetes mellitus, and antioxidants are believed to play role in controlling these alterations. In the present study, manganese (10 mg/kg body weight), copper (2 mg/kg body weight) and zinc (15 mg/kg body weight) were supplemented in alloxan-induced diabetic rats for a period of 28 days. There was statistically significant ($p<0.05$) decrease in the final fasting blood glucose concentration of supplemented and non-supplemented groups. In addition, there was statistically significant ($p<0.05$) increase between the final body weight of supplemented and non-supplemented rats In conclusion, supplementation with antioxidant micronutrients might improve blood glucose control and body wastages usually experienced in diabetics.

**Keywords**: Diabetes, Micronutrients, Blood glucose, Body weight

## INTRODUCTION

Requirement for micronutrients 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 (FAO/WHO, 2000).

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 results into polyphagia, polydipsia and polyuria, with attending nutrient lost and body wastages. Stephen (2005) 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.

In patient with diabetes mellitus, decreased levels of antioxidant micronutrient have been reported (Adewumi *et al.,* 2007). It is logical therefore, that these decreases might negatively influenced the activities of major antioxidant defence enzymes in the body, which requires these micronutrients as their cofactors and co-enzymes, with resultant elevation of markers of lipid peroxidation. Dallatu *et al* (2009) reported enhanced activities of some *de novo* antioxidant defence enzymes in alloxan-induced diabetic rats following supplementation with antioxidant micronutrients.

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The aim of this research is to study the effect of supplementation with antioxidant micronutrients, 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 the Animal House, Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Zaria, Nigeria. The animals were housed for one week under similar conditions in standard cages at 25 ± 2°C, with 12 hour light/dark cycle. The animals were maintained on water and animal feed (Vital Feeds, Jos) *ad libitum*.

### *Chemicals and micronutrients*

Alloxan was a product of Sigma Aldrich Chemical Co., UK while the assay kits for glucose was from Randox Laboratories, Co-Antrim, UK. All other reagents used for the study were of analytical grade. The micronutrients used in the study were purchased from a reputable pharmacy in Zaria Town, Kaduna State-Nigeria.

### *Induction of diabetes*

Experimental diabetes was induced by a single intraperitonial administration of freshly prepared alloxan monohydrate (150 mg/kg body weight) 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 determined using a glucometer based on glucose oxidase method (Trinder, 1969). Only rats that produced fasting blood glucose level of >126 mg/dl (> 7.00 mmol/l) set by WHO as diagnostic and partial destruction of pancreas tested with positive response to metformin were included in the study (WHO, 2003).

### *Animal grouping and micronutrient administration*

The rats were divided into 3 groups of 7 rats each: Group I: Control (received normal saline only); Group II, Diabetic treated not supplemented (DTNS) received orally, metformin (250 mg/kg body weight) only; Group III, Diabetic treated and supplemented with minerals (DTSM) received orally metformin (250 mg/kg body weight) + copper (2 mg/kg body weight) + manganese (10 mg/kg body weight) + zinc (15 mg/kg body weight). The supplementation and treatment was done on daily basis and lasted for 28 days.

### *Preparation of serum*

At the end of administration, the animals were fasted overnight and euthanized 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 serum was prepared for the determination of glucose concentration.

### *Determination of biochemical analytes*

Blood glucose concentration was assayed as described by the method of Trinder (1969). A known volume (10 µl) of the serum sample was mixed with 1 ml of glucose oxidase reagent, and incubated as 37°C for 30 minutes. Absorbance was read at 505nm. Digital bench weighing balance was used to measure their weights.

### *Statistical analysis*

Data were expressed as the mean ± SEM and were analyzed using Analysis of Variance (ANOVA) InStat3 Software. Differences in mean at $p<0.05$ was considered significant.

## RESULTS

The results of the current study were presented in Tables 1 and 2. Initial and final fasting blood glucose level at the beginning and end of the study period are depicted in Table 1. There was statistically significant decrease ($p<0.05$) between the final blood glucose level of the supplemented and unsupplemented animals. Furthermore, there was statistically significant increase ($p<0.05$) in the final body weight of the diabetic rats that were supplemented with

the micronutrients when compared with the diabetic non supplemented animals (Table 2).

Table 1: Initial and final fasting blood glucose of alloxan-induced diabetic rats supplemented with antioxidant micronutrients

| **Group** | **Initial Fasting Blood Glucose Level (mg/dl)** | **Final Fasting Blood Glucose Level (mg/dl)** |
|---|---|---|
| Control (normal saline only) | 77.29±8.65 | 75.00±7.22 |
| Diabetic control | 408.14±39.44* | 107.00±11.07* |
| Diabetic supplemented | 448.14±43.18* | 83.14±5.45** |

Values are Mean ± SEM of 7 determinations;
*Values differ significantly from controls;
** Values differ significantly from unsupplemented at $p<0.05$.

Table 2: Initial and final body weight of alloxan-induced diabetic rats supplemented with antioxidant micronutrients

| Group | Initial Body Weight (g) | Final Body Weight (g) |
|---|---|---|
| Control (normal saline only) | 155.14±4.25 | 157.57±4.16 |
| Diabetic control | 147.14±7.91 | 143.43±8.70* |
| Diabetic supplemented | 159.86±13.15 | 180.71±11.50** |

Values are Mean ± SEM of 7 determinations;
*Values differ significantly from controls;
** Values differ significantly from unsupplemented at $p<0.05$.

## DISCUSSION

Dietary pattern changes overtime and are dependent on factors such as agricultural practices, cultural and socioeconomic considerations. 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 (FAO/WHO, 2000). Reactive oxygen species (ROS) impairs insulin receptors, inactivate glycolytic enzyme glyceraldehyde-3-phosphate dehydrogenase and results in abnormal glucose homoestasis (Rahimi *et al.,* 2005). Trace elements are part of and interact with enzyme and hormones that regulate the metabolism of large amount of substrate (Isah, 2007). As such, deficiency must affect their metabolism including glucose.

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 improve the body weight of the supplemented rats. This is similar to the findings of Song *et al* (2009) who reported a decrease in food and water intake, and subsequent reduction in body weight of streptozotocin-induced diabetic rats. Adeleye *et al* (2007) reported an improved lowering of blood glucose in alloxan-induced diabetic rats, treated with metformin and supplemented with vitamin C. Mark and Ely (1984) reported that appropriate micronutrient supplementation can improve glucose tolerance and reduce auto-oxidation. El-Beshbishy (2005) 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* (1996) reported that, reactive oxygen species causes damage

to the membrane lipids, intracellular protein and DNA, and are believed to be efficient inducers of apoptosis. Jakus (2000) reported that the consequences of oxidative stress are damage to DNA, lipids, proteins, disruption of cellular homeostasis and accumulation of damaged molecules. These could be the basis of body wastage and reduction in weight observed in the present study.

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 defences, and minimize the potential danger associated with the insult. Therefore, the inclusion of antioxidant nutrients in the treatment of diabetics is hereby recommended.

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REFERENCES

Adeleye, A. A., Amole, O. O., Agbaje, E. O., Izegbu, M. C. and Elias, S. O. (2007). Effect of chronic co-administration of metformin and vitamin C on plasma glucose and lipid concentrations. Afr. J. Med. Sci., 36(2): 149-154.

Adewumi, M. T., Njoku, C. H., Saidu, Y., Abubakar, M. K., Shehu, R. A and Bilbis, L. S (2007). Serum chromium, copper and manganase levels of diabetic subjects in Katsina, Nigeria. Asian J. Biochem., 2(4): 284-288.

Dallatu, M. K., Anaja, P. O., Bilbis, L. S., Mojiminiyi, F. B. O. (2009). Antioxidant micronutrients potentials in strengthening the antioxidant defence in alloxan-induced diabetic rats. Nig. J. Pharmaceut. Service, 8(1): 89-94.

El-Beshbishy, H. A. (2005). Hepatoprotective effect of green tea extract against tamoxifen-induced liver injury in rats. Asian J. Biochem. & Mol. Biol., 38(5): 563-570.

FAO/WHO (2000). Vitamins and minerals requirement in human nutrition: Report of a joint FAO/WHO expert consultation. Bankok, Thailand.

Isah, H. S. (2007). Essential Clinical Biochemistry. 1st edn. Nigeria, Zaria: Tanaza Publishing Company. p. 145-147.

Jakus, V. (2000). The role of free radicals, oxidative stress and antioxidant systems in diabetic vascular disease. Bratisl Lek Listy, 101(10): 541-51.

Lasey, C. J., Murphy, M. E., Sanderson, M. J., Monteiro, E. F., Vail, A. and Schorah, C. (1996). Antioxidant micronutrients and HIV infection. Int. J. STD & AIDs, 7: 485-489.

Mark, F. C. and Ely, J. R. (1984). Rationale for micronutrients supplementation in diabetes. Medical Hypothesis. 13: 139-151.

Rahimi, R., Nikfar, S., Larijani, B. and Abdullah, M. (2005). A review on the role of antioxidants in the management of diabetes and its complications. Biomed. & Pharmacother., 59: 365-373.

Song, M. K., Roselthal, M. J., Song, A. M., Uyemura, K., Yang, H., Ament, M. E., Yanaguchi., D. T. and Comford, E. M. (2009). Body weight reduction in rats by oral treatment with zinc plus cyclo- (His-Pro). Br. J. Pharmacol., 158(2): 442-450.

Stephen, H. (2005). Diabetes and Syndrome X. http://www.powersurge.com.

Trinder, P. (1969). Annals of Biochemistry., 6:24: In., Cheesbrough, M. (1992)., Medical Laboratory Manual for Tropical Countries, ELBS, Cambridge. Vol. 1 (2nd ed.): 527-545.

WHO (2003). Expert Committee on Diagnosis of Diabetes Mellitus. Diabetes Care. 26: 3160-3167.