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ANTIOXIDANT AND HYPOGLYCEMIC POTENTIALS OF *MUSA PARADISIACA* AQUEOUS EXTRACT ON ALLOXAN/INDUCED DIABETIC ALBINO RATS

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ABSTRACT
Diabetes is one of the common pathologies involving oxidative stress in its aetiology and complications. This research was carried out to evaluate the hypoglycaemic and antioxidant properties of aqueous extract of unripe *Musa paradisiaca* of alloxan-induced albino rats. Thirty albino rats were divided into six groups, each group containing five rats. Group 1 (positive control), Groups 2 (induced diabetic control) and Group 3, 4, 5 and received 140, 180 and 220 mg/kg b.wt. of Musa *paradisiaca* once daily for 14 days. Group 6 was administered chlorpropamide (84 mg/kgb.wt.). The serum concentration of glucose of all the rats in each group was determined 48 hours after induction of diabetes and on the 7th and 14thday. There was significant ($p<0.05$) reduction of serum glucose in Groups 3, 4 and 5 when compared to the diabetic induced control group. The extract also increased significantly ($p<0.05$) the total GSH level, SOD and Catalase activities as well as decreased MDA level. The aqueous extract of *Musa paradisiaca* possesses antioxidant and anti-diabetic effects on alloxan induced diabetic rats.

Keywords:*Musa paradisiaca**,** hypoglycaemia**,** diabetic rats, antioxidant*.

INTRODUCTION
Diabetes mellitus (DM) has been documented by the World Health Organization (WHO) as one of the third highest risk factor for worldwide premature death (Oguntibeju, 2019).Statistics from the International Diabetes Federation (IDF) submits that about 415 million people live with diabetes in the world with a prevalence rate of 8.8% and 75% live in the third world countries (Oguntibeju, 2019). Uncontrolled DM is associated with oxidative stress (O.S), which predisposes to an increase in the incidence of diabetic complications (Rehman *et al.*, 2018). These include; cardiovascular disease (CVD), retinopathy, nephropathy and microangiopathy, neuropathy and several other complications(Yates *et al.*, 2015; Monserrat-Mesquida *et al.*, 2020).

In Nigeria, the current prevalence of DM was estimated to be about 4.7% with urban areas having the highest rates(Asmelash and Asmelash, 2019). The cure for diabetes is currently unknown, but the disease could adequately be managed using agents that have hypoglycaemic effect (Szkudelska *et al.*, 2020).

Musa paradisiaca commonly known as plantain is a widely cultivated plant in many parts of the world(Vilhena *et al.*, 2020). It belongs to the family Musacea. Different parts of the plants are used in folk medicine for a variety of ailments; Fruits, leaves, peels, root and stalks from plantain plants have been used orally or topically as a medicine for treating intestinal lesions in colitis, antilithic inflammation, pains, snakebite and antiulcer genic activity and in the treatment of DM (Vilhena *et al.*, 2020).-The aim of this study was to investigate the hypoglycaemic antioxidants potentials of aqueous extract of *Musa paradisiacal* (plantain) fruit on alloxan- induced diabetic rats.

MATERIALS AND METHODS
Sample collection and Preparation of unripe plantain fruits: Unripe plantains were purchased from "Yankura" market, Kano, Nigeria. The plantain was washed, peeled, sliced and shade dried. The dried slices were pulverized using mortar and pestle, then800 g of the ground was macerated with 3000 ml of distilled water. The mixture was filtered after 24hrs and then allowed to evaporate at 45°C on water bath.

Experimental Animals
Healthy adult Wister rats weighing 120–210 g wereprocured from the animal house of the Department of Zoology, Faculty of science, Bayero University, Kano, Nigeria. The animals were kept in a well-ventilated room and allowed free access to both food and water throughout the period of study. Guide lines of the National Institute of Health Guide for the care and use of laboratory animals was followed. The animals were divided into six (6)groups, each group comprised five (5) rats. Group 1 (positive control receives normal saline only). Group 2 (negative control; received 150mg/kg alloxan only). Groups 3 4 and 5 were treated with 140 mg kg$^{-1,}$ 180 mg kg^{-1} 220 mg kg^{-1} of the *Mus*a extract respectively, while group 6 was treated with84mg kg^{-1} body weight of chlorpropamide. The animals were treated once daily for a period of fourteen days. Blood samples (about 5 ml) were collected in EDTA tubes and used for glucose determination. Animals were made diabetic by a single intraperitoneal (I.P.) injection of alloxan monohydrate, dissolved in normal saline at a dose of 150 mg/kg body weight(Nakahara *et al.*, 2014).

Evaluation of Blood Glucose Level and Antioxidant Assay: Glucometer was used for the determination of blood glucose while assay kits purchased from Solarbio Life Science (China) were used for the determination of serum antioxidant activities

Statistical Analysis: The data was statistically analysed using Graph Pad Instat3 Software (2000) version 3.05 by Graph Pad Inc. Data are presented as Mean± SD.

RESULTS
The result obtained after treatment with the extract (Fig.1) showed a significantly higher ($p<0.05$) serum level of glucose in diabetic control when compared with the normal control rats. Group 3 and 4 did not decrease the serum levels of glucose significantly ($p<0.05$) compared to diabetic control rats. The serum level of glucose in Group 5

had their glucose level lowered significantly ($p<0.05$) when compared to the diabetic control group.

However, on the 14th day of treatment, the serum level of glucose was found to be significantly ($p<0.05$) higher in diabetic control rats when compared to normal control rats. Treatment with different doses of the extract caused a significant ($p<0.05$) fall in the serum levels of glucose, compared to diabetic induced rats. Nevertheless, there was no significant difference ($p>0.05$) between the normal control rats and Group 5. The serum level of glucose, in chlorpropamide treated rats was found to be significantly lower ($p<0.05$) when compared to Group 3 and 4. There was no significant difference in normal control ($p>0.05$) when compared to the Group 5 and the group administered with 84 mg / kg of chloropropamide.

The levels of SOD, CAT, and GSH (table1) increased significantly ($p<0.05$) after treatment with *M. paradisiacal* extract compared to the induced control; with concomitant decrease in the level of MDA decreased

DISCUSSION

DM is characterized by persisted elevated blood glucose levels, insulin resistance or deficiency(Vijay *et al.*, 2019).It has been documented that Oxidative stress can be induced, through alteration in mitochondrial function and NADPH oxidase enzyme system (Dludla *et al.*, 2017).In this study, we found that, the efficacy of the extract was dose dependent. The fasting blood glucose levels decreased as the duration of administration increased. This means that for effective glucose depletion, the extract must be taken for a long period to achieve the therapeutic concentration; which is 220 mg/kg for seven days according to current findings. Previous study on *Musa acuminata* which belongs to the same family, revealed a reduced plasma glucose utilisation of glucose in the peripheral tissues and facilitation of hepatic glycogen synthesis(Vijay *et al.*, 2019).Another study reported that 100 mg/ kg b.w.treatmentof rats with *M. Paradisiacal* leaves extract for 28 days stimulated insulin production, glucose utilization, decreased pro-inflammatory cytokines and free fatty acid level (Vijay *et al.*, 2019). Fibers from *M. Paradisiaca* fruit increased glycogenesis in the liver and lowered fasting blood glucose(Usha *et al.*, 1989).

Since cellular oxidative stress has been described to play key role in the development of hyperglycaemia-related tissue damage(Lucchesi *et al.*, 2013), we further studied the antioxidants activities of *M. paradisiacal* fruit Extract. The enzyme system SOD-CAT represents the first line of defence against free radical's molecular atrocities. SOD catalyses the dismutation of the superoxide anion radical (Panigrahi *et al.*, 2017). As a result, H_2O_2 is produced and decomposed by the CAT. In current research our extract decreased the extent of lipid peroxidation, as indicated by lower MDA level and increased the activities of SOD, CAT and GSH level. These collectively, ameliorated oxidative stress. This suggests that the *M. paradisiacal* fruit extract can also modulate cellular oxidative damage in addition to lowering blood sugar. Previous research recently reported, showed that *M. paradisiacal* pseudo stem extract inhibit oxidative stress and induced nephrolithiasis in rat (Panigrahi *et al.*, 2017).

CONCLUSION

The finding in this study indicated that the aqueous extract of *Musa paradisiaca* exert anti-diabetic effect by lowering blood glucose and inhibiting oxidative stress at its therapeutic concentration.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author Babandi, A. Conceptualized, designed and supervise the study. Author Kindzeka, L. S performed the experiment collected all data, and wrote the first draft of the manuscript. Author Muhammad B. Y did the literature search performed the statistical analysis and wrote the final manuscript. All authors read and approved the final manuscript

SIGNIFICANT STATEMENT

The study recommends that unripe plantain may be used as anti-diabetic agent alone or combined with the conventional anti diabetic drug because it has dual role serving as hypoglycaemic and antioxidant natural product. It is also recommended that molecular mechanisms of the extract should be investigated.

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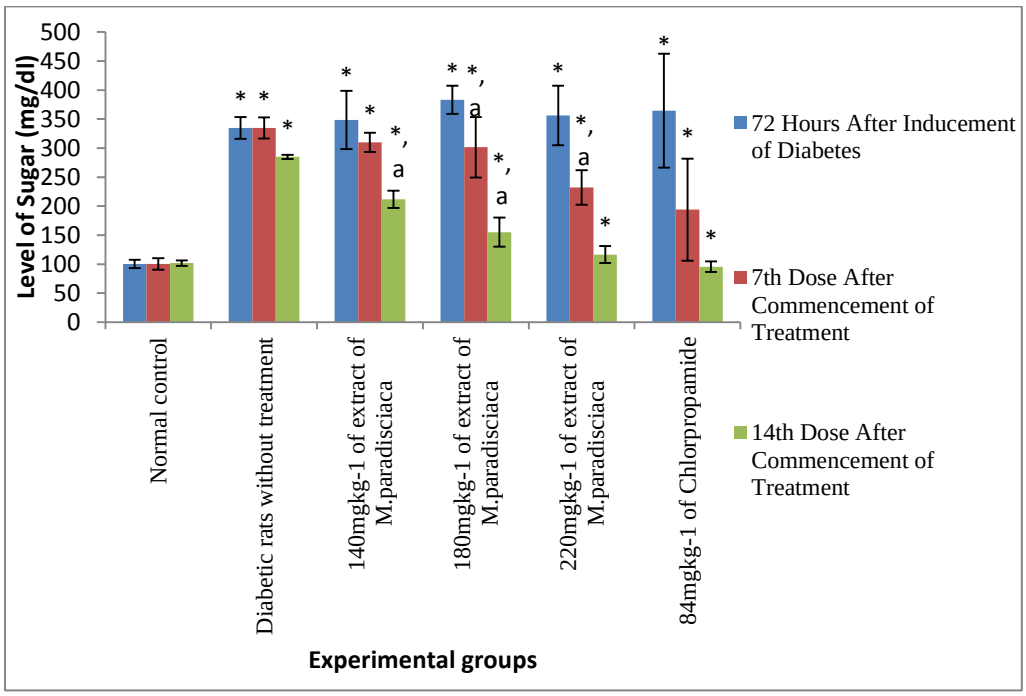

Figure 1: Blood glucose level 7th and 14th days After Commencement of Treatment with aqueous extract of unripe plantain and standard drug. Values with asterisk in each column are significantly different at $p<0.05$ compared to normal control; Values bearing superscript (a) in each column are significantly different at $p<0.05$ compared to diabetic control.