American Journal of Advanced Drug Delivery

http://www.imedpub.com/advanced-drug-delivery/

ISSN: 2321-547X

Original Article

Evaluation of Hypoglycemic and Hypolipidemic Potentials of Sweet Potato on a Wistar Albino Rat

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Date of Receipt- 03-06-2018
Date of Revision- 10-06-2018
Date of Acceptance-15-06-2018

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ABSTRACT

The lipidemic effect of methanol extract of *Ipomoea batatas* was evaluated in this study. A total of 18 adult female wistar albino rats were purchased from the Veterinary Department, University of Nigeria, Nsukka and acclimatized for a period of 2 weeks with Vital growers mash feed and water administered *ad libitum.* The animals were then grouped into 6 groups (n=3). Group 1 served as control while group 2 was administered gilbenclamide. Groups 3, 4, 5 and 6 were administered 1000 mg/kg, 750 mg/kg, 500 mg/kg and 250 mg/kg body weight of the extract daily. The administration was done for a period of 7 days and the animals were sacrificed, blood collected and serum collected for laboratory analysis. The result of analysis shows a significant ($p<0.05$) decrease in blood sugar level in the extract – treated groups when compared with the normal control. The lipid profile test also show a significant ($p<0.05$) decrease in VLDL and TAG in the treated group when compared with the normal control. This work shows that *I. batatas* is a good anti-lipidemic plant and will also serve as a good means of diabetes management.

Keywords: Hypoglycemic, Hypolipidemic, Sweet potato, Wistar Albino rats

INTRODUCTION

Diabetes mellitus is a metabolic disorder affecting carbohydrate, fat and protein metabolism. It affects nearly 10% of the population worldwide[1]. Thus represent a heterogeneous group of disorder with hyperglycemia which is due to impaired glucose utilization resulting from defective or deficient insulin secretory responses, along with hyperglycemia abnormalities in serum lipids[2-5]. Diabetes is associated with micro vascular and macrovascular complication which are the major causes of morbidity and death in diabetic subject[6,7].

Hypoglycemia is a common, potentially avoidable consequence of diabetes treatment and is a major barrier to initiating or intensifying anti-hyperglycemic therapy in efforts to achieve better glycemic control[8]. Therapy regimen and a history of hypoglycemia are the most important predictors of future events. Other risk factors include renal insufficiency, older age and history of hypoglycemia associated autonomic failure[9].

Reported rates of hypoglycemia vary considerably among studies because of differences in study design, definitions used and population included among other factors[10]. Although it occurs more frequently in type 1 diabetes, hypoglycemia also is chronically important in type 2 diabetes. Symptoms experienced by patient vary among individuals and many events remain undiagnosed[11,12].

The incidence of sever events is unevenly distributed with only a small proportion (5%) of individuals according for>50% of events. Consequently, clinician must be conscientious in obtaining thorough patient histories because an accurate picture of the frequency and severity of hypoglycemic events is essential for optimal diabetes management[13-15].

Severe hypoglycemia in particular is associated with an increased risk of mortality, impairment in cognitive function and adverse effect on patient quality of life[16].

Dyslipidemia is a known risk factor for cardiovascular disease, a common cause of morbidity and mortality even in developing countries[17]. The drug used to modulate lipid level in serum often

has deterious side effect[18].

A great number of medicinal plants have been used in the treatment of diabetes in different parts of the world. Some of which are without scientific scrutiny; the world health organization has also encouraged and recommended the use of plants as an alternative therapy for diabetes especially in countries where access to the conventional treatment of diabetes is not adequate[19-21].

Sweet potatoes (*Ipomea batatas*) are excellent sources of plant proteins with very low calories. Unlike other starchy root vegetables, it is used in folk medicine for the treatment of metabolic diseases[22]. Its leaves, the by-products possess activities of accelerating metabolism, preventing atherosclerosis, protecting eyesight, hypoglycaemia and antioxidant[23].

Ipomea batatas is used for the treatment of diabetes although its mechanism of action is enigmatic. The present study was therefore intended to investigate the anti-diabetic activity of *Ipomea batatas* extract and its effect on hepatic enzymes in alloxan induced diabetic rat[24].

Several reports have indicated that the phytochemicals in sweet potato possess multifaceted actions including antioxidant, anti-mutagenic, anti-inflammatory, antimicrobial and anti-carcinogenesis and thus are important for several health promoting functions in humans[25]. This present study is designed to determine the hypoglycemic and hypolipidemic potentials of sweet potato on a Wistar albino rat[26].

MATERIALS AND METHODS

Collection and Identification of Sweet Potato

The sweet potato where purchased from Umuahia main market at Obani and was identified by Dr. Omodamiro RM. After the identification, they were pilled and sliced and then air dried to a constant weight under the sun shield environment and was later milled to a powdered form.

Extraction of Ipomoea batatas (Sweet Potato)

100 g of milled sweet potato where mixed with 400 ml of methanol in a Bama bottle and shake in every 30 minutes for 3 days and extracted on the 3rd day. During the extraction; the filtrate was poured into the beaker to heat using the water and the bath solute was discarded. The solvent was evaporated to dryness leaving the sweet potato on the bottom of the beaker.

Animal Housing and Handling

Eighteen adult-female albino rats of (8-10 weeks of age) were purchased from University of Nigeria Nsukka. They were housed in stainless steel cages in the animal house of the Department of Biochemistry of Michael Okpara University of Agriculture Umudike, under-humid condition and allowed free access to Food (Vital Grower's Mesh) and clean tap water and were acclimatized for two weeks.

EXPERIMENTAL DESIGN

The extracted *Ipomoea batatas* was dissolved in water and was administered to the animal according to their body weight. The glucose level of the rat was taken in each of the group on the first day before administration.

The Group 2 was administered 5 mg/kg of the standard drug (Glibenachmide)

The Group 3 was administered 1000 mg/kg of the extract.

The Group 4 was administered 750 mg/kg of the extract.

The Group 5 was administered 500 mg/kg of the extract.

The Group 6 was administered 250 mg/kg of the extract.

The administration process were carried out for 7 days and the in glucose level was recorded in every 2 days of administration for that 7 days of administration, one hour after taken the meal glucose level in taken using a digital glucometer (Accu-Check Active).

Determination of Serum Total Cholesterol

Serum total cholesterol concentration was determined using the method of as contained in QCA commercial kit. Three (3) test tubes were set up in a test tube rack and labeled blank (BL), standard (ST) and sample (SA) respectively to the blank was added (10 µl) of distilled water, 10 µl standard specimen to the standard test tube and 10µl sample (serum) to the sample test tube. To each of these test tubes was added 100 µl of the cholesterol reagent. It was thoroughly mixed and incubated for 10 minutes at room temperature (RT) (20-25°C). The absorbance of the sample (A sample) against the blank was taken within 60 minutes at 500 nm.

Calculation:

The total cholesterol concentration in the simple was calculated using the general formula:

$$Te\ (mg/dl) = \frac{a\ sample\ X\ concentration}{A\ standard}$$

Determination of Serum triacylglycerol concentration

Serum triacylglycerol concentration was determined using the method of Albers *et al*. (1978) as contained in randox commercial KIT. A quality 0.1 ml of the sample was pipette into a clean tube labeled tube and 1.0 ml of trichloroacetic acid (TCA) was added to it, mixed and then centrifuged at 250 rpm for 10 minutes the supernatant was decanted and reserved for use. The assay procedure was carried out.

Calculation:

The concentration of triacylglycerol in serum was calculated as follows:

$$TAG\ (mg/dt) = \frac{A\ sample\ X\ concentration}{A\ standard}$$

Determination of Serum High Density Lipoprotein- Cholesterol Concentration

Serum HDL – cholesterol concentration was determined using the method of Albers *et al*., (1978) as contained in QCA commercial kits. The precipitant solution 0.1 ml was added to 0.5 ml of the serum sample and mixed thoroughly and allowed to stand for 15 min at room temperature (20-25°C); then centrifuge at 2,000 X g for 15 minutes. The cholesterol concentration in the supernatant was determined.

Calculations:

The HDL-cholesterol concentration in the sample was calculated using the following general formula:

$$HDL-cholesterol\ (mg/dl) = \frac{A\ sample\ X\ concentration}{A\ standard}$$

RESULTS AND INTERPRETATION

The results were analysed for mean significant difference using ANOVA (SPSS version 22.0) and accepted at $p<0.05$.

The figure below shows that the control group (98.86 ± 12.60) is non-significantly ($p>0.05$) higher when compared with 750 mg/kg (92.62 ± 11.82) groups, and non-significantly ($p>0.05$) lower when compared with 1000 mg/kg (104.49 ± 1.46), 500 mg/kg (105.83 ± 10.41) and 250 mg/kg (102.77 ± 6.57) groups (Figure 1).

The result in Figure 2 above shows a non-significant ($p>0.05$) increase in the control group (155.49 ± 9.15) when compared with the extract – treated groups. The 500 mg/kg and 250 mg/kg groups are significantly ($p<0.05$) higher than the 750 mg/kg and 100 mg/kg groups.

From the result below, the control group (52.84 ± 2.10) shows no significant ($p>0.05$) increase in HDL when compared with the other extract-treated groups. The extract – treated groups show a significant ($p<0.05$) increase (Figure 3).

From the chart below (Figure 4), there is a non-significant ($p>0.05$) increase in LDL of the control group when compared with the extract-treated groups.

The result in Figure 5 and 6 below shows a significant ($p<0.05$) decrease in the control (24.92 ± 1.33) when compared with 1000 mg/kg extract-treated group (36.62 ± 2.81). It (control) also showed a significant ($p<0.05$) increase when compared with the 750 mg/kg extract-treated group (18.20 ± 2.74).

DISCUSSION

Assessment of plasma lipid profile is required for the state of wellbeing of every individual as cardiovascular diseases and coronary heart diseases are silent, serial killers of our age[27,28]. The assessment of plasma haematological parameters can be used to determine how toxic a com pound can be to the blood parameters. Some Phytochemicals may have deleterious effects on the blood cells and to this end, it was necessary to determine the effect of the leaf extracts of *I. batatas* on serum lipid profile[29].

The dose sensitive increase in the concentration of HDL- cholesterol and reduction of the very low density lipoproteins cholesterol of the experiment showed that in the right dose, *I. batatas* can be used to treat cardiovascular diseases and coronary heart diseases, justifying its use in folk medicine for the treatment of cardiovascular diseases[30]. Added to it, this is the presence of flavonoids and other poly phenolic compounds which have the ability to scavenge for free radicals, therefore acting as antioxidants[31-33]. It has been established that free radicals help prevent cardiovascular diseases by interfering with the oxidation of the very low density lipoproteins and low density lipoproteins, which are the chief engineers of atherosclerosis. The increase in the concentration of triacylglycerol during the course of the study indicated that the plant had the ability to increase the rate of lipid breakdown; lipolysis, leading to the accumulation of TAG's. To this end it is justified why the plant is used as tonic in traditional medicine, since it facilitates the use of fatty acids as main energy source[34-37].

This increase in the rate of lipid breakdown may also have been responsible for the increase in the concentration of total cholesterol[38-40] because the breakdown of fatty acids via the beta oxidation pathway yields acetyl COA, which condenses to HMG coA (β- Hydroxy β-methyl glutaryl coenzyme A), then is reduced to Mevalonate by HMG COA reductase, the committed step in cholesterol biosynthesis[40-42].

From my results, there was a significant decrease in serum glucose concentration of diabetic animals treated with *Ipomoea batatas* extract compared to the normal control group[43,44]. This observation supports the report of Nishikant *et al*. and Ijaola *et al*. The possible mechanism by which aqueous extract of *Ipomoea batatas* brings about its hypoglycaemic action may be, by potentiating the insulin effect, either by increasing the pancreatic secretion of insulin from the cells of islets of Langerhan's or its release from bound insulin, thereby, decreasing the postprandial glucose in animals. This may be the cause of the increased body weight in *Ipomoea batatas* extract treated rats[45,46].

CONCLUSION AND RECOMMENDATION

From this work, it is seen that the methanol extract of *I. batatas* significantly reduced some lipid profile parameters responsible for atherosclerosis and sugar level as well. Thus, it is recommended that this plant be analysed in further studies so as to identify the phytochemical responsible for these activities.

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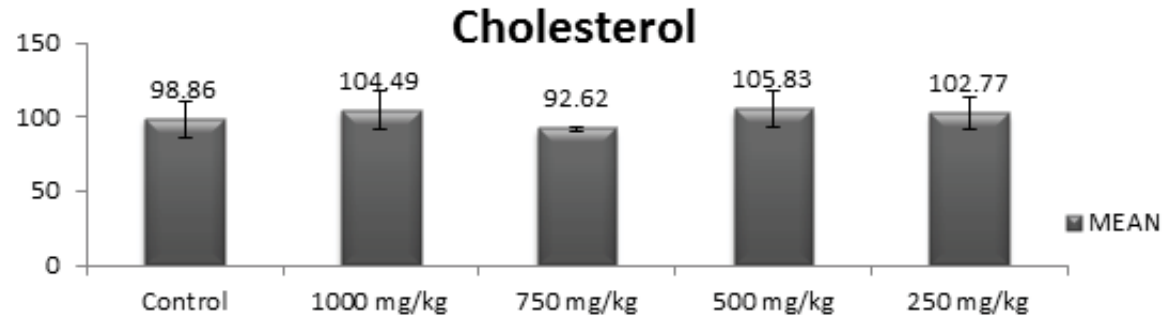

Figure 1. Effect of methanol extract of *I. batatas* on cholesterol level in Wistar albino rats

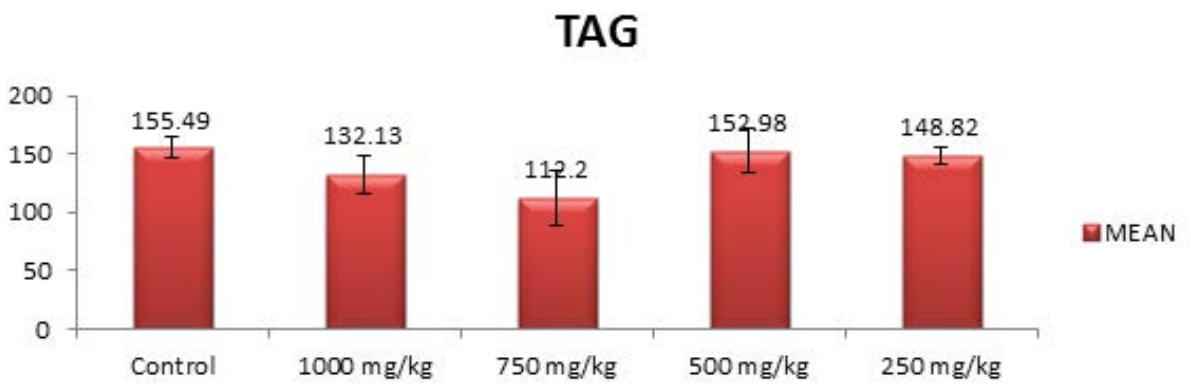

Figure 2. Effect of methanol extract of *I. batatas* on TAG level in Wistar albino rats

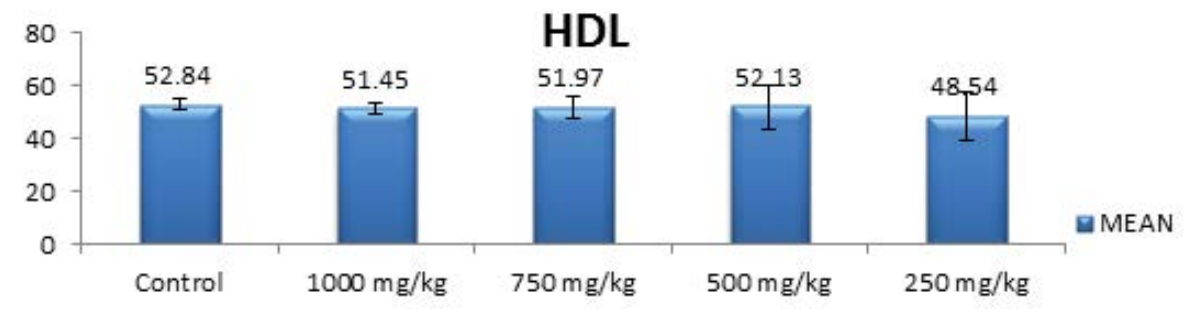

Figure 3. Effect of methanol extract of *I. batatas* on HDL level in wistar albino rats

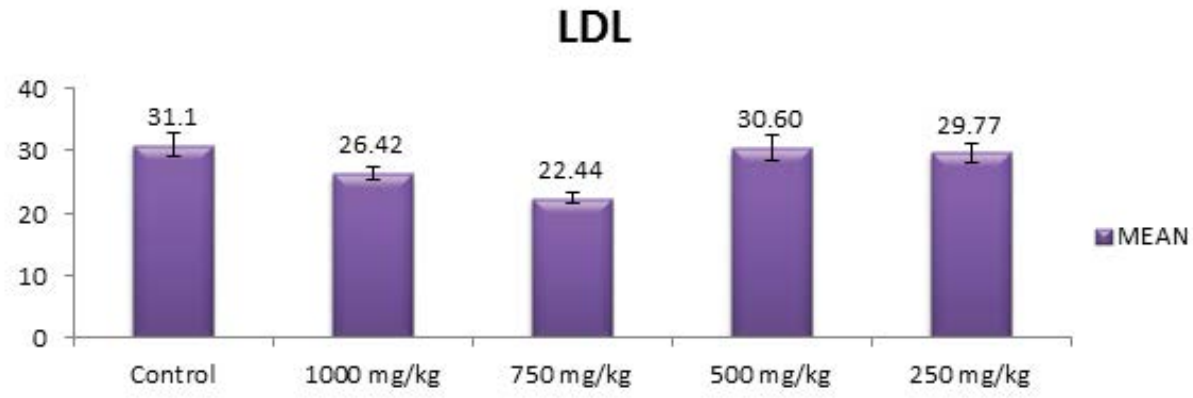

Figure 4. Effect of methanol extract of *I. batatas* on LDL level in wistar albino rats

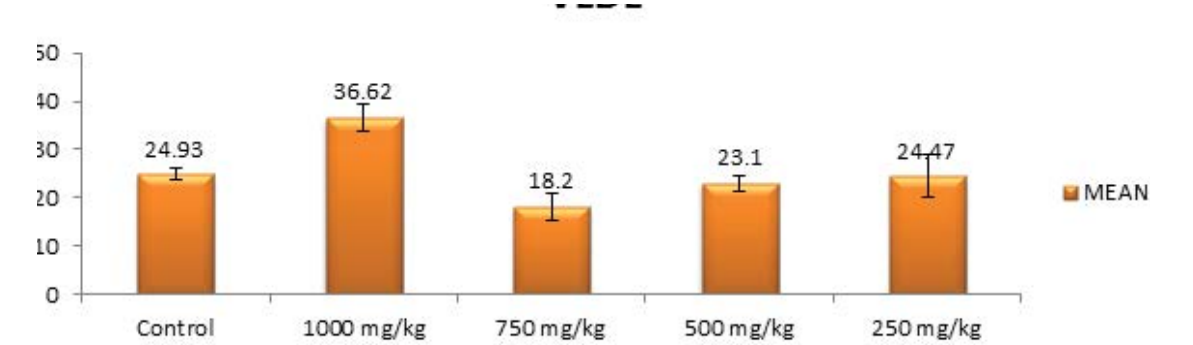

Figure 5. Effect of methanol extract of *I. batatas* on VLDL level in Wistar albino rats

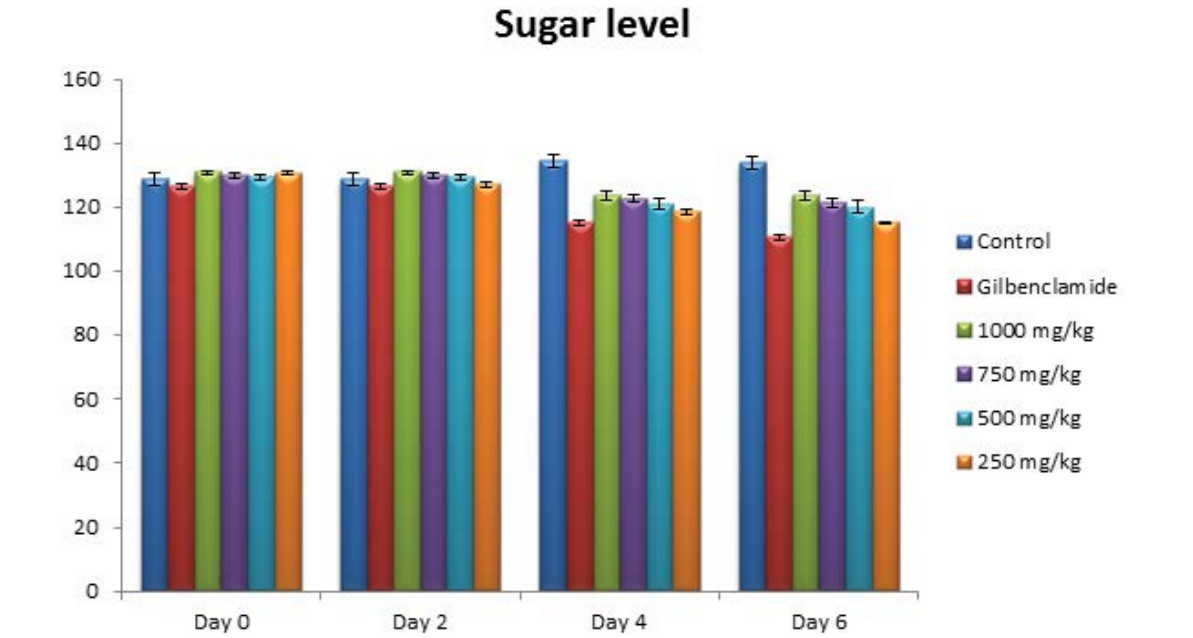

Figure 6. Effect of methanol extract of *I. batatas* on sugar level in Wistar albino rats