JBAAR
Journal of Basic And Applied Research
ISSN 2413-7014

Effects of Aqueous Tuber Extract of *Ipomea batatas* on Cardiac Enzymes, Lipid Profile and Organ Weights in Wistar Rats

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Received: 18-5-2016
Revised: 13-6-2016
Published: 16 -6-2016

Keywords:
Ipomea batatas, cardio-toxicity, lactate dehydrogenase, creatine kinase, lipid profile

Abstract: *Ipomea batatas (I. batatas)* commonly called Sweet potato are cultivated for food in more than 100 countries; the tuber is used as food without recourse to its toxic implications. Therefore, this research was designed to evaluate the effects of aqueous tuber extract of *I. batatas* on some organ weights, cardiac enzymes and lipid profile in Wistar rats. Twenty (20) male Wistar rats were divided into four (4) groups, each group consisting of five (5) animals. Group 1: was administered with distilled water while Groups 2, 3 and 4 were treated with 200,400, and 800 mg/ kg b.w doses of the extract of *I. batatas* respectively. The rats were sacrificed 24 h after treatment for twenty one (21) days. Serum obtained was used for analysis of the concentrations of creatine kinase (CK-MB), creatine kinase (CK), lactate dehydrogenase (LDH) and triglyceride, total cholesterol, low density lipoprotein, high density lipoprotein activity. Administered *I. batatas* extract at doses of 200, 400, and 800 mg kg^{-1} resulted significantly ($P < 0.05$) to increased mean weight of the body and organ weights (lung, liver and heart) of the rats respectively. There was a significant ($P < 0.05$) decrease in weight of testis but the effect on weight of seminal vesicle and epididymis was not significant ($P > 0.05$). There was reduction in the levels of triglyceride and total cholesterol, but this effect was not significant ($P > 0.05$). Administration of the extract at doses of 200, and 800 mg/kg b w significantly ($P < 0.05$) decreased the serum creatine kinase (CK-MB) and lactate dehydrogenase activity. These findings may probably suggest the cardio-protective effects of aqueous tuber extract of *I. batatas* at doses tested.

Cite this article as: Shafe, M.O., Eze, E.D., Ubhenin, A.E. and Tende J. A. (2016). Effects of Aqueous Tuber Extract of Ipomea batatas on Cardiac Enzymes, Lipid Profile and Organ Weights in Wistar Rats. Journal of basic and applied Research 2(4): 414-417

INTRODUCTION

Biomarkers are used to monitor drug therapies. They are central to the diagnosis and risk stratification of cardiac disease (Anthony and Adie, 2009). Cardiac markers are blood biomarkers of cardiac injury and disease (Ladenson, 2007). These included aspartate aminotransferase (AST) which was the first, lactate dehydrogenase (LDH), and creatine kinase (CK). AST was discovered to have a limitation in its use as cardiac biomarker due to its lack of specificity for cardiac tissue (Wroblewski and LaDue, 1955).

Lipid profile is a group of blood tests which are carried out to determine the risk of coronary artery diseases (CAD). Results of lipid profile are considered as good indicators of whether someone is prone to develop stroke or heart attack, caused by atherosclerosis. Tests included in lipid profile are total cholesterol (TC), triglyceride (TRIG), high-density lipoprotein-cholesterol (HDL-c) and low-density lipoprotein-cholesterol (LDL-c) (Sembulingam and Sembulingam, 2013).

Ipomea batatas (*I. batatas*) from the family Convolvulaceae is commonly known as sweet potato (Vandana and Madhav, 2015). It is an extremely versatile and delicious vegetable that possesses high nutritional value (Parle and Monika, 2015). From times immemorial the whole *I. batatas* plant including leaves, stem and tuberous root is used as traditional medicine (Parle and Monika, 2015). *I. batatas* is widely grown in tropical, subtropical and warm temperate regions and in Asian countries, particularly China (Vandana and Madhav, 2015).

Studies have shown that the tubers of *Ipomoea batatas* has a lot of health benefits ranging from anti- oxidant, anti-diabetic, wound healing, anti-bacterial, and anti-mutagenic, anti- hypertensive (Kusano and Abe, 2000; Vandana and Madhav, 2015). Pereda-Miranda and Bah (2003) had reported the use of the roots of *I. batatas* in the treatment of constipation. Therefore, the present study examined the effects of aqueous tuber extract of *I. batatas* on cardiac enzymes, lipid profile and organ weights in Wistar rats.

MATERIALS AND METHODS

Collection and identification of plant material

The tubers of *I. batatas* were bought in F.C.T town in Abuja, Nigeria. The tuber was then planted and allowed to bring forth leaves and flowers for its

identification. Botanical identification and authentication was carried out at NIPRD (National Institute for pharmaceutical research and development), Idu, Abuja, Nigeria. Herbarium specimen voucher number of NIPRD/H/6693 was collected by Mrs. Grace Ugbabe.

Preparation of aqueous tuber extract of *Ipomea batatas*

Aqueous extract of purple sweet potato tuber was prepared by the following procedure Sweet potato tubers were washed with tap water and weighed; after which they were then peeled and weighed then chopped into pieces (approximately 2 cm x 2cm x 2 cm). These pieces were then dried in the physiology laboratory of Bingham University, Karu at room temperature. The dried *I. batatas* was grinded with an electric blender into coarse powder. The grounded powder (1kg) was soaked in distilled 5 L water for 48-72 hours. The extract was then filtered in No. 1 Whatman filter paper. Dried aqueous extracts were obtained after removing the solvent by evaporation under reduced pressure using Rotary evaporator. The extract was stored in an air-tight container and kept in the refrigerator at 4 ^{0}C until use.

Phytochemical screening of *Ipomoea batatas*

The powdered tuber material was dissolved in 5 L of distilled water for 48 -72 hours. The extract was filtered using a Whatman No. 1 Filter paper. The filtrate of the extract was used to carry out the phytochemical screening (Ijaola *et al.*, 2014). The phyto-constituents analysis of the extracts was done using standard procedures with slight modifications (Trease and Evans, 1983; Sofowora, 1993).

Experimental Animals

Twenty (20) male Wistar rats were used for this research. These rats were obtained from Animal house in National Veterinary Research Institute, Vom, Jos town Plateau State Nigeria. This rat were acclimatized in the animal house of Bingham University for duration of three weeks and fed with growers mash, water was also made available *ad libitum*.

Animal Groupings and treatment

The animals were divided into four (4) groups of five rats each as follows:

Group 1: Control animals administered distilled water only

Groups 2: Administered 200 mg/body weight orally of *I. batatas* tuber extract

Group 3: Administered 400 mg/body weight orally of *I. batatas* tuber extract

Group 4: Administered 800 mg/body weight orally of *I. batatas* tuber extract

All treatments were given orally once daily for a period of three weeks.

Table 1: Phytochemical Screening of aqueous tuber extract of *I. batatas*

Phytochemicals	INFERENCE
Tannins	+
Saponins	+
Flavonoids	+
Terpenoids	+
Alkaloids	+
Anthraquinones	+
Reducing sugar	+
Cardiac glycosides	+

Table 2: Effects of aqueous tuber extract of *I. batatas* on organ weights (g) of Wistar rats

	Lung (g)	Liver (g)	Heart (g)	Testis (g)	Seminal vesicle (g)	Epididymis (g)
Control	1.03±0.10	5.50±0.54	0.53±0.03	1.27±0.07	0.21±0.01	0.14±0.02
200mg/kg of *I.batatas*	1.32±0.05	6.12±0.36	0.55±0.03	1.28±0.02	0.19±0.01	0.12±0.01
400mg/kg of *I.batatas*	1.13±0.05	5.21±0.23	0.55±0.05	1.20±0.09	0.20±0.02	0.14±0.02
800mg/kg of *I.batatas*	2.07±0.16*	7.73±0.50*	0.74±0.02*	1.05±0.06*	0.20±0.03	0.17±0.02

Values are presented as mean ± SEM

Values are statistically significant compared to control group at *P < 0.05

Table 3: Effects of aqueous tuber extract of *I. batatas* on body weight (g) of Wistar rats

	Week 1 Weight (g)	Week 2 Weight (g)	Week 3 Weight (g)
Control	138.00±5.90	138.00±5.90	139.50±6.38
200mg/kg of *I.batatas*	148.50±8.02	155.50±2.53	175.50±4.94*
400mg/kg of *I.batatas*	158.50±7.23	150.50±9.40	173.00±9.79*
800mg/kg of *I.batatas*	226.75±11.74*	217.25±10.31*	239.00±13.47*

Values are presented as mean ± SEM

Values are statistically significant compared to control group at *P < 0.05

Serum and heart collection

Rats were anaesthetized in a jar containing cotton wool soaked in diethyl ether, they were then sacrificed by jugular puncture and their blood collected in an un-heparinized bottle and allowed to stand for 10 min to clot. Serum was then collected using a Pasteur pipette. The rats were dissected, their hearts removed and wiped clean of blood. The hearts were immediately kept in ice-cold 0.25 M sucrose solution. They were then homogenized and used for the various analyses.

Preparation of serum and cardiac tissue homogenate

After the period (3 weeks) of experimental administration, animals were sacrificed and their organs were harvested. Blood sample for lipid profile analysis was collected through cardiac puncture in an un-heparinized bottle and allowed to stand for 10 min to clot. The clotted blood samples were then centrifuged at a revolution of 3500 per 15 minutes. Serum was collected using a Pasteur pipette for lipid profile analysis. The rats were dissected, their hearts removed and wiped clean of blood. The hearts were immediately kept in ice-cold 0.25 M sucrose solution. The homogenate of the cardiac muscle was prepared by careful washing the heart in normal saline; it was then homogenized with 5ml of phosphate buffer of pH 7.4 of 0.1 M using the laboratory mortar and pestle. The rats were dissected, their hearts removed and wiped clean of blood. The hearts were immediately kept in ice-cold 0.25 M sucrose solution. They were then homogenized and used for the various analyses.

Cardiac enzymes and lipid profile analysis

Measurement of lactate dehydrogenase (LDH), creatine kinase (CK), and creatine kinase (CK-MB) levels was done by colorimetric method using a kit made in France ELITECH GROUP Company. Serum total cholesterol, triglycerides and high density lipoproteins were estimated by enzymatic colorimetric end point methods using Span diagnostic reagent kit. Low density lipoprotein was calculated using the formula provided in cholesterol diagnostic kit booklet. All measurements were done using spectronic 21 digital Spectrophotometer (Bausch and Lomb, Rochester NY).

STATISTICAL ANALYSIS

All data obtained from each group were expressed as mean ± SEM. The data were statistically analyzed using (ANOVA) with Tukey's post hoc test to compare the levels of significance between the control and treated animals. All statistical analysis was done using SPSS version 17.0 software and Microsoft Excel (2007). The values of $P \leq 0.05$ were considered as significant.

RESULTS

Phytochemical screening showed that aqueous tuber extract of *I. batatas* contains tannin, saponin, flavonoid, terpenoid, alkaloid, anthraquinones, reducing sugars and cardiac glycosides (Table 1). Administration of *I. batatas* extract at doses of 200, 400, and 800 mg/ kg b w significantly ($P<0.05$) increased the mean weight of the body and organ weights (lung, liver and heart) of rats (Tables 2 and 3). There was a significant ($P < 0.05$) decrease in weight of testis but the effect on weight of seminal vesicle and epididymis was not significant. There was also no significant reduction in the levels of triglyceride and total cholesterol (Table 4). The administration of the extract at doses of 200, and 800 mg/kg b w also led to a decrease in serum creatine kinase (CK-MB) and lactate dehydrogenase activity (Table 5).

Table 4: Effects of aqueous tuber extract of *I. batatas* on Serum lipids profile Wistar rats

	Serum cholesterol (mmol/L)	Serum HDL (mmol/L)	Serum triglyceride (mmol/L)	Serum LDL (mmol/L)
Control	2.80±0.14	1.02±0.35	1.40±0.38	1.50±0.22
200mg/kg of *I.batatas*	2.43±0.12*	0.81±0.20	1.13±0.30	1.39±0.08
400mg/kg of*I.batatas*	2.60±0.01	0.94±0.24	0.89±0.01	1.49±0.24
800mg/kg of *I.batatas*	2.58±0.01	0.82±0.15	0.98±0.10	1.56±0.14

Values are presented as mean ± SEM
Values are statistically significant compared to control group at *P < 0.05

Table 5: Effects of aqueous tuber extract of *I. batatas* on cardiac biomarkers in Wistar rats

	LDH(IU/L)	CK(IU/L)	CK-MB(IU/L)
Control	71.75±23.07	477.25±163.40	366.75±85.85
200mg/kg of *I.batatas*	37.00±20.58*	564.25±139.43	157.00±42.09*
400mg/kg of *I.batatas*	80.25±39.75	480.50±212.71	412.75±118.92
800mg/kg of *I. batatas*	11.50±7.50*	482.25±175.83	262.00±156.57*

Values are presented as mean ± SEM
Values are statistically significant compared to control group at *P< 0.05

DISCUSSION

Phytochemical screening showed that aqueous tuber extract of *I. batatas* contains tannins, saponins, flavonoids, terpenoids, alkaloids, cardiac glycosides, anthraquinones, reducing sugars and cardiac glycosides. Phytochemicals like polyphenols, saponins, tannins, alkaloids and flavonoids have been linked to hypoglycemic, hypolipidemia, hypotension and hypolipidemic, and anti-atherosclerotic effects (Ijaola *et al.,* 2014). Studies have shown that the biological activities of alkaloids and flavonoids include hypoglycemic, hypolipidemia, hypotension among other activities. Flavonoids have also been documented to possess immune-modulating activity and antioxidant properties in addition to its hypoglycemic, hypolipidemic, and anti-atherosclerotic effects (Ijaola *et al.,* 2014).

The mean weight of the body of the rat increased significantly ($P < 0.05$) in the groups treated with aqueous tuber extract of *I. batatas* at doses of 200, 400 and 800 mg/kg b w for three weeks, when compared to the normal control animals. The increment in the groups treated with of 200, and 400 mg/kg b w started from the third week of treatment, whereas the groups treated with the dose of 800 mg/kg b w started from the first week up to the last week of treatment. Administration of aqueous tuber extract of *I. batatas* at dose of 800 mg/kg b w for three weeks resulted in increase in the weights of lung ,liver and heart and decrease in weight of testis but had no significant effect on weight of seminal vesicle and epididymis. The effects on weight gain could be attributable to increased synthesis of proteins or enzymes and even accumulation of fat cells in these organs. In addition, some reports indicated that tannins, saponins, volatile oils, saponin glycosides and alkaloids could account for the observed increase in organ weights. It may be the evidence of myocardial hypertrophy that is often difficult to recognize. The decrease in the weight of testis of rats in the group treated with *I. batatas* extract could suggest testicular damage, however more clinical study need to be conducted to ascertain this elucidate this effects.

An increase in blood lipid profile especially with a reduced high density lipoprotein enhances the development of atherosclerosis and cardiovascular related disease (Nwanjo, 2004). Results showed that there was a reduction in the levels of triglyceride and total cholesterol at all the doses of the extract tested, but the decrease was not significant when compared to the normal control animals.

The serum enzymes, creatine kinase (CK), creatine kinase (CK-MB) and lactate dehydrogenase (LDH) serve as sensitive indices to assess severity of myocardial ischemia. Serum CK activity is a more sensitive indicator in early stage of myocardial ischemia, while peak rises in LDH is proportional to the extent of injury of the myocardial tissue (Chatterjea and Shinde, 2002). The administration of the extract at doses of 200, and 800 mg/kg b w also produced a significant decrease in serum CK-MB and LDH activity. This results further confirms that the integrity of cardiac membrane was maintained by the extract and thus preventing the leakage of the enzyme into the serum.

CONCLUSION

The results of the present study may probably suggest the cardio-protective effect of aqueous tuber extract of *I. batatas* at the dose tested. It is recommended that further studies should be carried out to ascertain the mechanism(s) by which the extract exerts its effects.

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