

Assessment of the Anti-Diabetic and Some Biochemical Effects of *Myrianthus aboreus* on Wistar Rats

Chibuike Obiandu^{1*}, Kinikanwo Green²

¹Department of Human Physiology, Faculty of Basic Medical Sciences, University of Port Harcourt, Nigeria

²Department of Obstetrics & Gynaecology, Faculty of Clinical Sciences, University of Port Harcourt, Nigeria

*Corresponding author: Chibuike Obiandu

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Abstract

Myrianthus aboreus is a medicinal plant that is widely distributed in Africa but common in Delta and Edo states of Nigeria. It is applied in folklore remedies in the treatment of some illnesses. This study was done to investigate the antidiabetic potential of the leaf of *Myrianthus aboreus* and its effects on some biochemical parameters of male wistar rats. The rats were divided into four (4) groups of five (5) rats each. Group one (1) which served as non diabetic control received normal saline only. Group 2 served as diabetic control and received normal saline after induction. Group three (3) and group four (4) were diabetic rats treated with 500mg/kg bw and 1000mg/kg bw of the hydromethanolic leaf extract of *Myrianthus aboreus* respectively, for a period of four (4) weeks. The results obtained showed that the higher dose extract caused a significant decrease in blood glucose level in week 4 of the study. The changes observed in the plasma concentrations of electrolytes, urea and creatinine were not statistically significant. This study showed that, the leaf extract of *Myrianthus aboreus* demonstrated hypoglycemic effects in alloxan induced diabetic wistar rats.

Keywords: *Myrianthus aboreus*, diabetic wistar rats, hydromethanolic, hypoglycemic.

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INTRODUCTION

Medicinal plants are becoming increasingly useful in the treatment of diverse illnesses. The vast majority of people in Africa and other developing countries rely on medicinal plants for basic health care [1, 2]. The therapeutic importance attached to medicinal plants is attributed to the fact that they are readily available, easily affordable and also associated with minimal side effects, when compared to modern medicines [3]. Also, medicinal plants are rich reservoirs of biologically active compounds used in the synthesis of new or complimentary/conventional drugs, which has contributed immensely to human health and wellbeing [4]. *Myrianthus aboreus* is a medicinal plant widely distributed in some regions of West, Central and East Africa where it is found in forest stretched along rivers [5, 6]. Some ethnobotanical investigations carried out in Nigeria showed that the leaves of *Myrianthus aboreus* are popularly consumed as vegetable especially, in the Delta and Edo states where the plant is found in abundance [7].

It is highly recognized as a plant with profound medicinal properties and has a wide range of application in folklore remedies. There are reports of its use traditionally, in the treatment of amenorrhoea [8]; jaundice, vomiting, fever and dysentery [9, 10]. In

addition, the use of *Myrianthus aboreus* in the treatment of diabetes is a common practice in African folk medicine [11].

Some scientific studies that has been carried out showed that the extracts of *Myrianthus aboreus* possess anti nociceptive effects [12]; exhibits antibacterial activity [13] and demonstrates antioxidant potentials [11], which was due to the phenolic compounds present in the extract. *Myrianthus aboreus* have been reported to possess a wide range of bioactive compounds such as, alkaloids, flavonoids, tannins and saponins [14]. In addition, some other phytochemical compounds including triterpenes, pentacyclic triterpenic diacids and myriantic acid have been extracted from the leaves of *Myrianthus aboreus* [15, 16]. Although, *Myrianthus aboreus* is used traditionally in treatment of diabetes, there is still paucity of scientific reports on its efficacy. The global prevalence of diabetes mellitus is increasing and rapid urbanization with lifestyle changes has been identified as predominant contributory factors in Africa and Asia [17]. Diabetes mellitus which is a complex disorder affecting various aspects of human metabolism can lead to several organ damage including the kidney, especially, when poorly managed. Management of diabetes is a challenging task but, the cost and side effects associated with drug use has increased the demand for natural products with

antidiabetic activity. The objective of this study is to investigate the antidiabetic potential of the leaf of *Myrianthus aboreus* and the effects on some plasma electrolytes [such as, sodium ion (Na⁺), potassium ion (K⁺), chloride ion (Cl⁻) and bicarbonate ion (HCO₃⁻); urea and creatinine].

MATERIALS AND METHODS

Preparation of Plant Material

Fresh leaves of *Myrianthus aboreus* procured from local dealers in Delta state, Nigeria were identified in the herbarium, Department of Plant Science and Biotechnology, University of Port Harcourt, Nigeria. The leaves were washed and dried at room temperature (26°C) over a duration of 3 weeks. They were milled to fine powder using a grinding machine. The total quantity obtained weighed 400g. Each 100g was soaked in 400ml of hydromethanol (20%:80%) for 48 hours. The solution was filtered and the extract was concentrated using a rotary evaporator at 45°C. The net yield was stored in a refrigerator at 4°C until used. Finally, the extract was reconstituted to obtain 500mg/ml and 1000mg/ml of solution for animal oral treatments.

Animal Models

Twenty (20) adult male wistar rats, bred in the experimental animal house of Faculty of Basic Medical Sciences, University of Port Harcourt, Nigeria; and weighed between 140–160g at the beginning of experiment were used for the study.

The animals were housed in clean cages and allowed two weeks to acclimatize with conditions of the housing facility with surrounding temperature of 26–28°C and adequate ventilation. The animals were fed with standard rat chows and water *ad libitum*. The handling of animals conformed to the guiding principles in the care and the use of laboratory animals published by the American Physiological society [18].

Experimental Design

The male wistar rats were divided into four (4) groups of five (5) rats each. Group one (1) which served as non-diabetic control received normal saline only. Group two (2) served as diabetic control and received normal saline after induction. Group three (3) served as diabetic treated group and received normal saline plus 500mg/kg of extract of *Myrianthus aboreus* daily after

induction. Group 4 served as diabetic treated group and received normal saline and 1000mg/kg of extract of *Myrianthus aboreus* daily after induction. The extracts were administered as single oral doses per day using animal feeding hypothermic syringes for four (4) weeks. The animals were sacrificed under chloroform anaesthesia on day 29 after 24 hours of last administered dose.

Induction of Diabetes

A single (150mg/kg body weight) dose of alloxan monohydrate in normal saline was injected into the rats intra-peritoneally in accordance to the method described by Ebong *et al.*, [19]. Blood samples were collected by caudal venepuncture after 72 hours and the glucose level was measured using the glucometer. The rats with blood glucose level above 200 mg/dl were considered diabetic and included in the study.

Blood glucose were monitored weekly throughout the period of experiment and on the last day of experiment.

Collection of Blood and Analysis

Blood samples were collected at the end of the experiment into appropriate sample bottles and were allowed to stand and later centrifuged at 3000 rev/min for 15 minutes. The plasma obtained was stored at -20°C until used for electrolytes, urea and creatinine assay.

Electrolytes analysis was done using SFRI 4000 ion selective electrode, while plasma urea and creatinine were analyzed using Cobas C111 autoanalyzer.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 20.0 was used for the statistical analysis of data. Results were expressed as Mean ± SEM. The differences between means were determined using the one-way analysis of variance (ANOVA) and considered statistically significant at $p < 0.05$.

RESULTS

Result Presentation

The result of this study are presented in the tables and figure below.

Table-1: Mean blood glucose level of diabetic and non diabetic groups

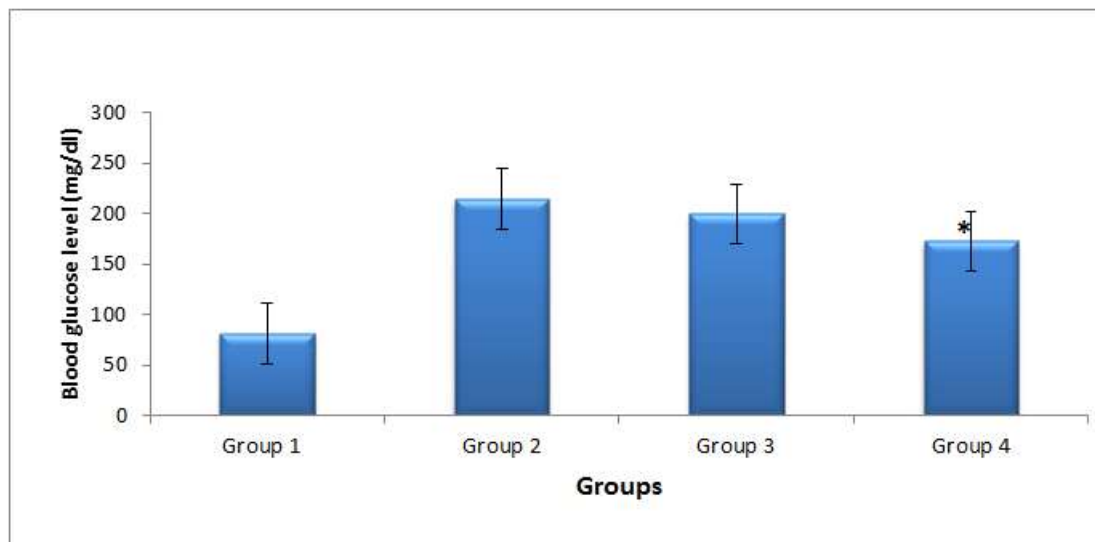
Groups	Pre Induction	Induction	Week 1	Week 2	Week 3	Week 4
1	79.60±3.87	80.20±3.20	77.60±2.32	81.40±3.16	80.00±1.79	81.00±3.38
2	77.60±5.15	230.40±4.31	218.40±6.24	217.20±3.93	218.80±6.28	214.20±4.20
3	77.60±4.17	218.00±5.83	213.00±6.63	208.00±7.35	202.00±9.70	199.60±10.87
4	78.80±3.26	216.00±7.48	204.00±8.08	206.80±8.01	200.00±10.00	172.60±15.03*

Values expressed as Mean ± SEM. n=5. Significant at [$*(P < 0.05)$] when compared to group 2 (Diabetic control) within the period.

Table-2: Mean electrolytes, urea and creatinine concentrations of diabetic and non diabetic rats

Groups	Na ⁺ (mmol/L)	K ⁺ (mmol/L)	Cl ⁻ (mmol/L)	HCO ₃ ⁻ (mmol/L)	Urea (mmol/L)	Creatinine (μmol/L)
1	137.20±2.50	4.80±0.37	98.00±5.59	28.00±0.45	4.40±0.19	97.20±8.73
2	138.40±0.93	5.20±0.58	103.40±5.60	28.00±0.45	5.10±0.29	98.80±9.73
3	137.60±1.21	4.40±0.51	94.00±5.44	27.80±0.58	4.60±0.24	93.80±8.86
4	135.40±1.33	4.20±0.37	92.00±6.20	28.00±0.45	4.50±0.32	90.20±11.20

Values expressed as Mean ± SEM. n=5.

**Fig-1: Blood glucose level of various groups at the end of study (week 4)**

Result analysis

In Table-1, the mean blood glucose level of diabetic and non diabetic rats are highlighted. The group 1 represents the non diabetic control, group 2 represents diabetic control while group 3 and group 4 represents the diabetics treated with 500mg/kg and 1000mg/kg extracts of *Myrianthus aboreus* respectively. There were no observed significant ($P<0.05$) differences in the blood glucose level of the treated diabetic rats from pre Induction to week 3 of study when compared to the diabetic control. But there was a significant ($P<0.05$) reduction in blood glucose level of group 4 when compared to group 2 at week 4. Table-2 show the mean electrolyte, urea and creatinine concentration of the various groups. There was an observed marginal increase in the plasma concentration of electrolytes, urea and creatinine levels in exception of bicarbonate in the diabetic control group. Similarly, the plasma concentration of electrolyte, urea and creatinine levels were observed to be marginally decreased in the treated diabetic groups when considered in respect to the diabetic control. In Figure-1, the blood glucose levels of the various groups at end of study (week 4) are highlighted with a significant decrease in group 4 when compared to group 2.

DISCUSSION

Medicinal plants have long been employed in the management of diabetes mellitus. The blood glucose level of the diabetic control rats (Table-1) was

significantly higher than that of non-diabetic rats. The increase in blood glucose level was similarly reported in alloxan induced diabetic rats that received no other form of drug treatment during the study [19]. The ability of alloxan to cause damage and death of the insulin-secreting cells of the pancreas in experimental animal models is responsible for the resultant hyperglycaemia, hence diabetes [20]. The cell destructive action of alloxan is mediated by reactive oxygen species. Alloxan and dialuric acid, a product of its reduction sets into motion a series of actions leading to the generation of reactive oxygen species and ultimately the rapid destruction of B-cells, thereby, precipitating experimental diabetes mellitus [20]. Diabetes mellitus is a condition characterized by increase in serum glucose concentration [21], thus making abnormally high blood glucose level, a marker of diabetes.

In this study, baseline pre induction glucose level in the experimental rats were found to be normal in all the groups but the baseline post induction measurements showed a significant [$P<0.05$] increase in the blood glucose of rats which received alloxan. The blood glucose level remained significantly high in the diabetic rats which did not receive extract of *Myrianthus aboreus* throughout the period of experiment. The blood glucose concentration of diabetic rats which received the lower dose of *Myrianthus aboreus* decreased over the period of administration but this reduction was not statistically

significant ($P < 0.05$) compared to the diabetic control rats. The blood glucose concentration of diabetic rats treated with the higher dose of *Myrianthus aboreus* extract showed non-significant ($P < 0.05$) reduction during the initial three weeks of administration however, this change became significant after four weeks when compared to the diabetic control rats. The hypoglycemic properties of plants may be due to their ability to stimulate possible insulin release and uptake of peripheral glucose [22], which in turn may have reversed alloxan induced hyperglycemia. The phytochemical compounds found in *Myrianthus aboreus* may have contributed to the antidiabetic activity. The reduction in blood glucose observed in the treated diabetic groups may have been influenced by the presence of saponin and flavonoids which are phytochemical constituents reportedly found in the extract of *Myrianthus aboreus* [14]. Flavonoids and phenolic compounds are diabetes induced free radical scavengers which are also associated with increase insulin secretion [23]. Flavonoids also have the ability to trigger regeneration of damaged pancreatic beta cells in diabetic rats [24]. In a study, it was reported that saponins also possess blood glucose lowering effects [25]. Prolonged hyperglycemia in diabetes mellitus may lead to damage in some tissues such as the kidney, thereby presenting with renal insufficiency. In this study, plasma electrolytes such as sodium, potassium, chloride ions; creatinine and urea levels were assayed to assess the effects of extracts of *Myrianthus aboreus* in any possible diabetes induced renal dysfunction in diabetic rats treated with same extract. The mean plasma sodium, potassium, chloride and bicarbonate ion levels were not significantly ($P < 0.05$) altered in this study, when the treated diabetic and non treated diabetic (diabetic control) groups were compared to the non diabetic control (normal) group and when the treated diabetic groups were compared to the non treated diabetic control group at the end of four weeks of study. The mean plasma urea and creatinine concentrations were marginally higher in the diabetic control (Group 2) which received no treatment following induction compared to the treated diabetic rats. Although, these changes were not statistically significant ($P < 0.05$), the extracts of *Myrianthus aboreus* may be involved in causing a marginal reduction of these parameters in the treated diabetic rats when considered in respect to the non treated diabetic rats. However, the degree and duration of persistent hyperglycemia may determine the onset of organ damage especially, the kidney. Blood urea and creatinine levels are bio-markers which are also used to assess and monitor renal function in diabetics with poorly controlled diabetes [26]. The glomerular filtration, tubular reabsorption and tubular secretion are important roles of the kidney which also reflect their functional state.

Serum levels of urea and creatinine are useful predictors of renal damage and indicate prognosis in diabetic patients [27]. But the effective control of

blood glucose levels can prevent progression to diabetic nephropathy thereby, causing marked reduction in morbidity and mortality associated with diabetes mellitus [26]. The extract of *Myrianthus aboreus* may be useful in the treatment of diabetes mellitus due to its hypoglycemic effects in alloxan induced diabetic wistar rats.

CONCLUSION

The extracts of *Myrianthus aboreus* possess antidiabetic activity at the dose of 1000mg/kg body weight administered in four weeks but did not significantly alter electrolytes, urea and creatinine levels within the period of study.

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