Open Science Journal of Pharmacy and Pharmacology
2015; 3(6): 72-79
Published online November 2, 2015 (http://www.openscienceonline.com/journal/osjpp)

Phytochemical Composition and Antidiabetic Properties of Aqueous Stem Extract of *Pennisetum purpureum* on Alloxan – Induced Diabetic Wistar-Albino Rats

Akuru Udiomine Brantley[1], Akaninwor Joyce O.[2], Amadi Benjamin Achor[2]

[1]Department of Chemistry, Rivers State University of Science and Technology, Port Harcourt, Nigeria
[2]Department of Biochemistry, University of Port Harcourt, Port Harcourt, Nigeria

Email address

minebrant@yahoo.com (Akuru U. B.), akaninworo@yahoo.com (Akaninwor J. O.), benjaminachor2004@yahoo.com (Amadi B. A.)

To cite this article

Akuru Udiomine Brantley, Akaninwor Joyce O., Amadi Benjamin Achor. Phytochemical Composition and Antidiabetic Properties of Aqueous Stem Extract of *Pennisetum purpureum* on Alloxan – Induced Diabetic Wistar-Albino Rats. *Open Science Journal of Pharmacy and Pharmacology.* Vol. 3, No. 6, 2015, pp. 72-79.

Abstract

Phytochemical composition and antidiabetic properties of aqueous stem extract of *Pennisetum purpureum* on alloxan –induced diabetic wistar-albino rats was assessed. Phytochemical analysis was carried out on the plant using gas chromatophrapy. While the anti-diabetic study was carried out on twenty eight (28) wistar albino rats administered with the aqueous stem extract for 21 days, after which blood samples were collected and subjected to biochemical parameters viz blood glucose, lipid profile, liver enzymes test and haematological parameters. The rats were divided into seven groups of four rats each designated as C, D, A200mg/kg, D200mg/kg, D400mg/kg, D600mg/kg and Dmet®. Diabetes was induced in all the groups, except group C (positive control) and A200mg/kg (sample control). Group D (negative control) was not treated while the other groups were treated with aqueous stem extract of *Pennisetum purpureum* and a reference drug (metformin® 1.4mg/kg), which was administered orally to the animals once per day for 21 days at varying concentrations of 200mg/kg, 400mg/kg and 600 mg/kg body weights. The blood glucose levels were examined for 7, 14 and 21 days. Phytochemical analysis indicated the presence of alkaloids, flavonoids, tannins and phenols. The flavonoid content revealed the presence of anthocyanin (0.06%), kampferol (0.09%), rutin (2.10%), catechin (2.49%) tannins (67.89%), lunamarine (26.21%) an alkaloid, and phenol (1.16%). The aqueous stem extract exhibited significant ($p<0.05$) reduction in the blood glucose concentration of the albino rats at 400mg/kg of the aqueous stem extract of the plant. The aqueous stem extract also compared favourably with the standard reference drug (metformin®). There was significant ($p<0.05$) reduction in triglyceride, very low density lipoprotein and white blood cell levels while high density lipoprotein level, cholesterol and low density lipoprotein level have no significant difference ($p>0.05$). It can be concluded that aqueous stem extract of *Pennisetum purpureum* might possibly be used for treating diabetes and its related complications (hyperlipidemia).

Keywords

Diabetes, *Pennisetum purpureum*, Phytochemical Analysis, Antidiabetic Properties

1. Introduction

Diabetes mellitus is a common metabolic disorder characterized by increase in the blood sugar along with alterations in carbohydrate, fat and protein metabolism, associated with defects in insulin secretion and/or insulin action, or both (Dineshkumar *et al.,* 2009). Diabetes is one of the most important diseases worldwide, reaching epidemic proportions. Global estimates predict that the proportion of adult population with diabetes will increase 69% for the year 2030 (Maria-Luisa and Cristina, 2013). Chronic hyperglycemia is associated with microvascular and macrovascular complications that can lead to visual impairment, blindness, kidney disease, nerve damage, amputations, heart disease, and stroke. These complications account for premature mortality and most of the social and economic burden in the long term of diabetes (Maria-Luisa

and Cristina, 2013).

Pennisetum purpureum (Schumach), commonly known as elephant grass or Napier grass belongs to the *Poaceae* (*alt. Gramineae*) family. It is called 'Achara' by the Ibo speaking people of South Eastern Nigeria. It is generally used as animal food, an ornamental and for erosion control (Okaraonye and Ikewuchi, 2009). The dried matured shoots are used for making fences in Northern Nigeria. The matrixes of the matured shoots are used for preparing the special soup called 'ofeachara" by the Ngwa and Umuahia people of Abia State, in South Eastern Nigeria (Okaraonye and Ikewuchi, 2009). Phytochemical and proximate analysis was carried out by Okaraonye and Ikewuchi (2009) and *Pennisetum purpureum* was found to be rich in tannin, alkaloids, flavonoids and saponins with tannin having the highest concentration.

Some of these phytochemicals are said to have beneficial properties. Alkaloids, flavonoids, saponins and tannins are known to have antimicrobial, as well as other physiological activities (Okaraonye and Ikewuchi, 2009). Also Tannins such as tannic acid stimulate the transport of glucose and inhibit adipocyte differentiation (Maqsood *et al.,* 2008). Flavonoids have a wide range of biochemical and pharmacological activities in mammals and other biological systems. They possess anti-inflammatory, antioxidant, anti-allergic, hepatoprotective, anti-thrombic, antiviral and anti-carcinogenic activities (Okaraonye and Ikewuchi, 2009). Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intralumenal physicochemical interaction, hence, it has been reported to have hypocholesterolemic effects (Okaraonye and Ikewuchi, 2009). They may thus aid in lessening the metabolic burden that would have been placed on the liver.

Several works have been carried out on *Pennisetum purpureum* (Achara) but none on its antidiabetic properties. Hence, the objective of this study, which is to evaluate the antidiabetic properties of aqueous stem extract of *Pennisetum purpureum*.

2. Materials and Methods

Preparation of Plant Extract and Phytochemical analysis

2.1. Collection of Plants

Fresh edible portion of *Pennisetum purpureum* (Achara) stem were bought from mile 3 market from traders in Port Harcourt, Nigeria. The plant was identified and authenticated by Dr. (Mrs) O. B. Green, of the Department of Plant Science and Biotechnology, Rivers State University of Science and Technology, Rivers state.

2.2. Processing of Plant Material

The plant was washed in a running tap water to get rid of the dirt. The outer, hard and fibrous portion of the plant was removed and discarded, while the inner fresh, tender and edible portion was retained. These were cut into smaller bits and oven-dried (model) to a constant weight at 40°C and ground into powder. The sample was stored in a clean glass ware until required for analysis.

2.3. Aqueous Extraction of Plant Material

Five hundred grams (500g) of the powdered sample was mixed with a 2000ml of distilled water. The mixture was stirred severally and covered and left overnight (12hours) at room temperature and then filtered using a Whatman's filter paper No. 1. The filtrate was then concentrated to a constant weight in a water bath at 80°C and was later stored at 4°C.

2.4. Determination of Phytochemical Content of Crude Plant Extract

Phytochemical analysis was carried out using Gas chromatophraphic standard method (AOAC, 1990).

2.5. Experimental Design for Antidiabetic Study

Twenty eight (28) wistar-albino rats weighing between 100-125g were used for the study. The animals were obtained from the Animal House of the Department of Biochemistry, University of Port Harcourt, Choba, Rivers state. All the animals were housed in the animal house, University of Port Harcourt, Choba campus.

The rats were randomly distributed into seven groups of four rats each, such that the initial mean weights of the groups were equalized as nearly as possible and housed individually in cages. The rats were acclimatized for 7 days with free access to feed (Top feed grower's mash) and water *ad libitum*. After acclimatization, feeding was discontinued, leaving the rats with free access to only water for 6hr after which their weights (initial weights) were taken. All procedures and techniques in handling the animals were according to standard methods.

Table 1. *Experimental design for antidiabetic screening.*

S/N	Groups/ Tittle	Treatment
1	Control (C)	Rats fed with normal feed only
2	Diabetic (D)	Rats induced with diabetes only(150mg/kg Alloxan)
3	Achara200mg/kg (A200mg/kg)	Rats not induced with diabetes but administered 200mg/kg of aqueous stem extract of *Pennisetum purpureum* (achara) only
4	D200mg/kg	Rats induced with diabetes(150mg/kg Alloxan) and treated with 200mg/kg of aqueous stem extract of *Pennisetum purpureum* (achara)
5	D400mg/kg	Rats induced with diabetes (150mg/kg Alloxan)and treated with 400mg/kg of aqueous stem extract of *Pennisetum purpureum* (achara)
6	D600mg/kg	Rats induced with diabetes (150mg/kg Alloxan)and treated with 600mg/kg of aqueous stem extract of *Pennisetum purpureum* (achara)
7	Dmet®	Rats induced with diabetes (150mg/kg Alloxan) and treated with 1.4mg/kg of metformin t®

Administration of the extract was done orally. Animals received their doses once a day for 21 days. At the end of the treatment period, the rats were fasted overnight, weighed and euthanized by exposure to chloroform vapour for a period of 5mins. They were then painlessly sacrificed and the blood collected from each rat for biochemical and haematological analysis.

2.6. Induction of Diabetes

Hyperglycaemia was induced by a single intraperitonal injection of 150mg/kg alloxan monohydrate diluted in citrate buffer to the rats previously fasted for 12hr overnight. Six hours (6hrs) after the induction, the rats were maintained on 5% glucose solution for 24hours to prevent hypoglycaemia that may result from acute massive pancreatic release of insulin. Rats with blood glucose level of 10mmol/l to 31mmol/l were used for the study (Yerima *et al.,* 2013).

3. Biochemical Analysis

Glucose concentration was assayed using a glucometer and glucose strip. Total cholesterol (TC), high density lipoprotein (HDL) and Triglyceride (TG) concentrations were assayed enzymatically using Randox commercial test kits (Randox laboratories Ltd, Crumlin, England, UK).

Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) cholesterol concentrations were estimated using the Friedewald equation (Friedewald, 1972).

The plasma aspartate transaminase (AST), alanine transaminase (ALT) activities were determined using Randox test kits (Randox Laboratories Ltd, Crumlin, England, UK) at 546nm by monitoring the concentrations of oxaloacetate and pyruvate hydrazines respectively formed with 2,4-dinitrophenylhydrazine. The activity of alkaline phosphatase (ALP) was determined by monitoring the degradation of p-nitro- phenylphosphate to p-nitrophenol, at 405 nm.

4. Determonation of Haematological Indices

Packed Cell Volume (PCV) was determined using Cheesbrough (2005) method**.** The PCV was read using a micro-haematocritreader. Total white blood cell count was estimated by visual count method using Turkes solution to lyse the red blood cell, leaving the white blood cells to be counted. The red cell count was estimated by visual method, viewed under the microscope.

Statistical analysis

All data obtained in this study were subjected to statistical analysis using one-way Analysis of Variance (ANOVA). All analyses were done using Statistical Package for Social Sciences (SPSS) version 20.0 (IBM Statistics, UK). All the values were reported as mean ± standard error of mean (SEM) and the results were considered significant at $p<0.05$ i.e. at 95% confidence level.

5. Results

5.1. Phytochemical Profile of *Pennisetum purpureum* (Achara)

The results of the phytochemical analysis of *Pennisetum purpureum* (Achara) are shown below.

Table 2. *Phytochemical Profile of Pennisetum purpureum (Achara).*

COMPONENT	CONCENTRATION (µg/ml)	CONCENTRATION (%)
Anthocyanin	0.54±0.00	0.06
Phenol	11.07±0.00	1.16
Tannin	647.72±0.00	67.89
Lunamarine	250.11±0.00	26.21
Catechin	23.76±0.00	2.49
Rutin	20.00±0.00	2.10
Kampferol	0.90±0.00	0.09
Total composition	954.12±0.00	100

Values are as mean± standard error of mean.

There was very high concentration of Tannins (67.89%) and Lunamarine (26.21%), while Catechin (2.49%), Rutin (2.10%), Phenol (1.16%), Kampferol (0.09%) and Anthocyanin (0.06%) had very low concentration.

5.2. Biochemical Studies

Table 3. *Effect of aqueous stem extract of Pennisetum purpureum (Achara) on Weight (g) of Alloxan Induced Diabetic Wistar Albino Rats.*

Groups	Weight (g)			
	Initial weight of rats(g)	Weight of rats(g) One week after treatment with plant extract	Weight of rats(g) 2 weeks after treatment with plant extract	Weight of rats(g) 3 weeks after treatment with plant extract
Control (C)	125.00±0.00	128.75±1.25^{cd}	175.00±0.00	176.25±1.25
Diabetic(D)	100.00±0.00	93.75±6.25^{ab}	143.75±6.25	132.50±5.91
Achara 200mg/kg(A200mg/kg)	125.00±0.00	128.75±1.44^{cd}	156.25±6.25	150.00±10.21
D200mg/kg	112.50±7.22	117.50±5.95^{ab}	165±13.38	137.5±7.22
D400mg/kg	100.00±0.00	100±0.00^{ab}	125±36.08^{ab}	125±36.08
D600mg/kg	100.00±0.00	112.5±7.22	125±0.00	118.75±6.25
Dmet®	112.50±0.00	87.5±7.22^{ab}	116.67±31.46	150±38.86^{ab}

Values are expressed as Mean ± SEM (n=4). Means in a column bearing different alphabetic superscript differ significantly ($p< 0.05$).

There was significant increase ($p < 0.05$) between the diabetic groups when compared with Achara 200mg/kg group only, after one week of treatment while the other groups had no significant difference ($p>0.05$). Also in week one, there was no significant difference ($p>0.05$) between the control and other groups. On the second week, there was significant difference ($p<0.05$) between the control group and diabetic group treated with 400mg/kg of aqueous stem extract of *Pennisetum purpureum*. On the third week after treatment, there was no significant difference ($p > 0.05$) between the diabetic group and other groups but D400mg/kg group had a constant weight with the second week of treatment while other treated groups had decrease in weight apart from Dmet® group.

Table 4. *Effect of aqueous stem extract of Pennisetum purpureum (Achara) on blood glucose (mmol/L) concentration of alloxan -induced diabetic wistar albino rats.*

Groups	Glucose concentration (mmol/l)				
	Glucose conc. after Inducing Diabetes before treatment with Plant extract	Confirming diabetes before treatment with Plant extract	One week after treatment with Plant extract	2 weeks after treatment with Plant extract	3 weeks after treatment with Plant extract
Control(C)	6.65 ± 0.29^{cd}	6.62 ± 0.40^{cd}	6.62 ± 0.69	6.52 ± 1.07	5.62 ± 0.28
Diabetic(D)	26.30 ± 1.76^{ab}	20.10 ± 0.95^{ab}	10.10 ± 0.24	6.97 ± 0.56	4.52 ± 0.44
Achara 200mg/kg(A200mg/kg)	6.78 ± 0.26^{cd}	6.80 ± 0.191^{cd}	6.00 ± 0.84	4.90 ± 0.14	4.75 ± 0.26
D200mg/kg	11.48 ± 0.16^{ab}	10.98 ± 0.63^{ab}	7.72 ± 1.60	4.90 ± 0.14	4.75 ± 0.26
D400mg/kg	17.65 ± 0.48^{ab}	17.60 ± 0.47^{ab}	8.90 ± 0.14	$4.90\pm0.14^{ab;cd}$	4.05 ± 0.21^{ab}
D600mg/kg	21.50 ± 0.87^{ab}	21.32 ± 0.92^{ab}	8.75 ± 0.46	5.25 ± 0.69	5.12 ± 0.59
Dmet®	23.02 ± 0.85^{ab}	22.95 ± 0.87^{ab}	9.07 ± 1.79	6.30 ± 0.10	5.00 ± 0.98

Values are expressed as Mean ± SEM (n=4). Means in a column bearing different alphabetic superscript differ significantly ($p< 0.05$).

In Table 4, all groups except the control and Achara 200mg/kg group were diabetic after inducement of diabetes. The fasting blood glucose concentration of the alloxan treated animals were significantly higher ($p<0.05$) than the untreated animals (control and Achara 200mg/kg). On week one after treatment, there was no significant difference ($p > 0.05$) between the diabetic group and other groups. On week two after treatment, the fasting blood glucose concentration of group D400mg/kg only (4.90 ± 0.14mmol/l), was significantly lower ($p<0.05$) than the control and diabetic groups while the other groups had no significant difference ($p>0.05$). On week three after treatment, group D400mg/kg (4.05 ± 0.21mmol/l) had the lowest fasting blood glucose concentration and was significantly lower ($p<0.05$) than control group but not significantly lower ($p>0.05$) than the diabetic group. The other groups had no significant difference ($p>0.05$) when compared with the control and diabetic groups.

Table 5. *Effect of aqueous stem extract of Pennisetum purpureum (Achara) on Liver Enzymes of Alloxan Induced -Diabetic Wistar Albino Rats after three weeks of Treatment.*

Groups	AST(U/L)	ALT(U/L)	ALP(U/L)
Control(C)	25.00 ± 2.00	11.25 ± 2.13	24.25 ± 2.84
Diabetic(D)	25.25 ± 2.65	10.25 ± 1.31	45.25 ± 1.55
Achara 200mg/kg (A200mg/kg)	19.00 ± 2.83	13.50 ± 2.18	30.25 ± 0.25
D200mg/kg	23.20 ± 2.59	14.50 ± 2.84	32.00 ± 2.29
D400mg/kg	29.00 ± 8.41	14.50 ± 4.30	51.00 ± 1.47
D600mg/kg	18.00 ± 1.58	9.00 ± 1.00	37.00 ± 2.45
Dmet®	$7.00\pm1.75^{ab;cd}$	13.67 ± 3.61	43.67 ± 11.16

Values are expressed as Mean ± SEM (n=4). Means in a column bearing different alphabetic superscript differ significantly ($p< 0.05$).

There was significant decrease ($p<0.05$) in the AST activity of Dmet® group rats when compared to the control and diabetic group. However, no significant difference ($p >0.05$) for ALT and ALP in all the groups.

Table 6. *Effect of aqueous stem extract of Pennisetum purpureum (Achara) on Lipid Profile of Alloxan Induced-Diabetic Wistar-Albino Rats after three weeks of Treatment.*

Groups	T.C (mmol/l)	T.G (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	VLDL (mmol/L)
Control(C)	2.25 ± 0.05	0.82 ± 0.02	1.57 ± 0.14	0.30 ± 0.15	0.37 ± 0.03
Diabetic(D)	2.55 ± 0.17	0.95 ± 0.06	1.42 ± 0.02	0.68 ± 0.14	0.43 ± 0.01
Achara 200mg/kg (A200mg/kg)	1.90 ± 0.08	$0.30\pm0.06^{ab;cd}$	1.77 ± 0.11	-0.01 ± 0.12	$0.13\pm0.19^{ab,cd}$
D200mg/kg	2.40 ± 0.21	0.45 ± 0.05^{cd}	0.90 ± 0.05	1.29 ± 0.16	$0.20\pm0.02^{ab;cd}$
D400mg/kg	2.10 ± 0.61	0.70 ± 0.21^{cd}	1.50 ± 0.41	0.31 ± 0.15	$0.31\pm0.49^{ab;cd}$
D600mg/kg	2.90 ± 0.24	0.57 ± 0.12	1.45 ± 0.05	0.68 ± 0.20	0.26 ± 0.02
Dmet®	2.27 ± 0.62	$0.43\pm0.11^{ab;cd}$	1.20 ± 0.30	1.26 ± 0.32	$0.19\pm0.05^{ab,cd}$

Values are expressed as Mean ± SEM (n=4). Means in a column bearing different alphabetic superscript differ significantly ($p< 0.05$).

There was significant decrease ($p < 0.05$) in the plasma triglyceride and VLDL level of Achara 200 mg/kg (0.30 ± 0.06mmol/l; 0.13 ± 0.19mmol/l) and Dmet® (0.43 ± 0.11mmol/l; 0.19 ± 0.05mmol/l) groups when compared to control group and diabetic group after three weeks of treatment while D200mg/kg (0.45±0.05mmol/l) and D400mg/kg (0.70±0.21mmol/l) groups had a significant decrease ($p<0.05$) in plasma triglyceride level when compared with the diabetic group after three weeks of treatment but had no significant difference ($p>0.05$) when compared to the control. Also, D200mg/kg (0.20±0.02mmol/l) and D400mg/kg (0.31±0.49 mmol/l) had significant reduction ($p<0.05$) in VLDL level when compared to the control and diabetic groups. D600mg/kg (0.57±0.12mmol/l; 0.26±0.02mmol/l) had lower though not significantly different ($p>0.05$) triglyceride and VLDL level when compared to the control and diabetic groups respectively.

There were no significant difference ($p > 0.05$) in the Total cholesterol, HDL cholesterol and LDL cholesterol levels, when compared with control and diabetic group.

Table 7. *Effect of aqueous stem extract of Pennisetum purpureum (Achara) On Haematological Parameters after three weeks of Treatment.*

Groups	Hb(g/dl)	PCV(%)	RBC ($x10^{12}$/L)	WBC ($x10^{9}$/L)	N(%)	L(%)
Control (C)	14.33±0.42	43.00±1.25	6.42±0.41	6.30±0.64	35.00 ± 2.88	65.00 ± 2.89
Diabetic (D)	13.83±1.06	41.50±1.22	5.73±0.62	6.57±0.22	29.00 ± 1.68	71.00 ± 1.68
Achara 200mg/kg(A200mg/kg)	13.08±0.42	39.25±1.25	5.22±0.19	6.75±0.32	26.25±2.39	73.75±2.39
D200mg/kg	14.50 ±0.29	43.50±0.86	6.55±0.24	4.30 ± 0.12	30.25±1.84	69.75±2.75
D400mg/kg	14.50 ± 4.19	43.50±12.57	6.55±1.89	$3.65±1.06^{ab;cd}$	41.00±11.84	59.00 ± 17.05
D600mg/kg	13.57±0.250	40.75±0.75	5.65±0.28	3.42±0.22	40.50±2.63	59.50 ± 4.21
Dmet®	14.00 ± 3.5	42.00 ± 10.57	6.23±1.57	4.57±1.14	31.67±8.00	68.33±17.12

Values are expressed as Mean ± SEM (n=4). Means in a column bearing different alphabetic superscript differ significantly ($p< 0.05$).

From Table 7, there was no significant difference ($p > 0.05$) in the packed cell volume, haemoglobin, red blood cell and neutrophil count (N), lymphocyte level of the test groups and the control group. There was significant reduction ($p<0.05$) only on D400mg/kg of white blood cell count of treated diabetic wistar albino rats.

6. Discussion

The result of the phytochemical analysis is shown in Table 2. It indicates the presence of alkaloids, flavonoids, tannins and phenols. Recently, many researchers have reported that various plant-derived flavonoids, stimulate glucose uptake in cells. Similarly, certain flavonoids exhibited hypoglycemic activity and are known for their ability of beta cell regeneration of pancreas (Vijayanand *et al*., 2014). Flavonoids present in the plant are Kampferol, which had been shown to have anti-ulcer, anti-inflammatory, antiviral and anticancer activities (Bimlesh *et al.,* 2011); Rutin, antiulcer, antibacterial, antiviral, antiallergic and antithrombosis activities (Bimlesh *et al.,* 2011), and catechin has been shown to have anti-inflammatory and anti-hepatitis properties (Dilipkumar and Preeti, 2013). Also Anthocyanin, a flavonoid was present in the plant. Anthocyanin has the ability to decrease triglycerides and increase HDL-cholesterol levels in rats. It can also protect pancreatic β-cells from glucose-induced oxidative stress due to its antioxidant property, having anti-diabetic activity (Dilip and Tetsuya, 2007).

Tannins have been observed to reduce hperglycemia by enhancing glucose uptake through mediators of the insulin-signalling pathways, such as PI3K (Phosphoinositide 3-Kinase) and p38 MAPK (Mitogen-Activated Protein Kinase) activation and GLUT-4 translocation (Kumari and Jain, 2012). Lunamarine a quinolone-alkaloid, present in *Pennisetum purpureum,* has the ability to reduce arterial blood pressure (Macabeo and Aguinaldo, 2008).

Table 3 shows that there was significant increase ($p < 0.05$) only at Achara 200mg/kg group compared to the diabetic untreated rats after one week of treatment on the weights of the alloxan-induced diabetic wistar-albino rats while 200mg/kg, 400mg/kg and metformin® diabetic treated animals had significant difference ($p < 0.05$) when compared to the control group. On the second week of treatment, 400mg/kg and 600mg/kg had significant difference ($p < 0.05$) compared to the diabetic untreated group. On the third week, there was no significant difference ($p> 0.05$), but there was decrease in 200mg/kg, 600mg/kg treated diabetic group while 400mg/kg treated diabetic group had a constant weight and 1.4mg/kg of metformin® diabetic treated group had a slight increase though not significantly different ($p > 0.05$) from the diabetic untreated group. Weight loss is a symptom of type 1 diabetes (Emily, 2005) which was caused by alloxan-induced diabetes (Tripathi and Verma, 2014). The constant weight of 400mg/kg diabetic treated rats at the second and third week may be due to some components present in the aqueous stem extract of *Pennisetum purpureum* (Achara) which may have mimicked or stimulated the actions of growth factors hence its ability to enhance the repair and regeneration of damaged pancreatic tissue or increased insulin secretion (Pandey *et al*., 2011; Akter *et al.,* 2014). While 1.4mg/kg metformin® weight gain occurred since metformin enhances insulin-stimulated glucose utilization in peripheral tissues and increased insulin-stimulated glycogen synthesis (Jack, 2003).

The results for the effect of aqueous stem extract of *Pennisetum purpureum* (Achara) on blood glucose level is shown in Table 4. There was significant reduction ($p < 0.05$)

in blood glucose concentration in all the treated groups except 1.4mg/kg of metformin® diabetic treated group in the 1st and 2nd week of treatment compared to the diabetic untreated group. But in the 3rd week of treatment, there was reduction (though not significantly different $p > 0.05$) in blood glucose concentration on only 400mg/kg of treated diabetic group while other groups had higher blood glucose concentration compared to the diabetic untreated group. The mechanism of the antidiabetic properties of the extract (especially at 400mg/kg) is not well known, but it may be related to the ability of the extract to stimulate sufficient production of insulin by the pancreas that aided in the peripheral utilization of glucose in the cells or a possible ability of the extract to regenerate the β cells to carry out its functions. It may also be due to the high content of phytochemical like tannic acid has been shown to enhance glucose uptake and stimulates secretion of insulin from pancreatic β cells (Ikewuchi, 2012b).

Aspartate aminotransferase is one of the enzymes responsible for the transfer of amino group in gluconeogenesis. AST concentration is highest in the hepatic and cardiac tissues. Elevated levels of this enzyme are usually interpreted as indicative of hepatic damage (Varley *et al*., 1980).

The results of the effect of aqueous stem extract of *Pennisetum purpureum* (Achara) on liver enzymes of alloxan-induced diabetic-wistar albino rats after three weeks of treatment is shown in Table 5. There was significant reduction ($p < 0.05$) in 1.4mg/kg of metformin® treated diabetic groups of aspartate aminotransferase (AST), while all other groups no significantly different at $p > 0.05$. This therefore indicates that the extract did not have any effect on AST- activity and thus, may not cause hepatic injury.

Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) are examples of other enzymes used as markers of hepatic function. There was no significant difference ($p > 0.05$) in the enzyme activities and thus the extracts may not cause any hepatic injury.

Insulin is a potent inhibitor of lipolysis. During diabetes, activity of lipase enzyme increases lipolysis and release more free fatty acids in the circulation because of lack of insulin. Increase in fatty acid concentration in turn increases the beta-oxidation of fatty acids by increasing the activity of HMG-CoA reductase, producing more cholesterol. Insulin also increases the receptor-mediated removal of LDL-cholesterol and decreased activity of insulin during diabetes causes hypercholesterolemia (Vijayanand *et al*., 2014). Also, over-accumulation and abnormal deposition of cholesterol is a well-established risk factor for developing atherosclerosis and other cardiovascular diseases (Sheriff, 2004).

The effect of aqueous stem extract of *Pennisetum purpureum* (Achara) on lipid profile of alloxan induced diabetic wistar-albino rats three weeks after Treatment is shown in Table 6. All the plant extract and 1.4mg/kg of metformin® treatments significantly reduced plasma levels of triglycerides (TG) (Table 6) compared to the diabetic group. The decrease in TG level of all plant extract and 1.4mg/kg of metformin® treatment may be due to increased insulin secretion from the beta cells of the pancreas which activates lipoprotein-lipase enzyme that hydrolysis TG for storage in the adipocytes (Lee *et al*., 2000; Sheriff, 2004; Munazza *et al.,* 2011). However Table 6 shows that administration of plant extract and metformin®, had no significant reduction ($p > 0.05$) in total cholesterol level, high density lipoprotein and low density lipoprotein levels in all treated groups.

VLDL are secreted by liver and export triglyceride to peripheral tissues, where triglyceride are hydrolysed by lipoprotein lipase, yielding free fatty acids for storage in adipose tissue and oxidation (Malloy and Kane, 2010). High plasma levels of VLDL cholesterol is a risk factor for cardiovascular disease (Ikewuchi, 2012a) and often accompanies diabetes mellitus (Ikewuchi, 2012a). In this study, there was significant reduction ($p < 0.05$) of plasma VLDL cholesterol level in Achara 200mg/kg, D200mg/kg, D400mg/kg and metformin® treated animals when compared to the control and diabetic group. Indicating the extract can possibly be used to reduce cardiovascular disease.

Assessment of haematological parameters can be used to determine the extent of deleterious effect of foreign compounds including plant extracts on the blood constituents of an animal (Elekofehinti *et al.,* 2012). It can also be used to explain blood relating function of chemical plant extract (Elekofehinti *et al.,* 2012). Red Blood Cell count is a haematological parameter used to check anaemia and to evaluate normal erythropoiesis. Haemoglobin level indicates the amount of intracellular iron helps to determine the degree of anaemia (Asanga *et al.,* 2013). Anaemia occurs frequently in type 1 diabetes, due to oxidative stress which increases erythrocyte osmotic fragility leading to shortened lifespan of erythrocyte (Sada *et al.,* 2013). There was no significant difference ($p > 0.05$) in the counts of Red Blood Cell (RBC), Packed Cell Volume (PCV), Haemoglobin concentration, Neutrophile and Lymphocye count. This would indicate that the aqueous stem extract of *Pennisetum purpureum* (Achara) do not have any effect on the above mentioned parameters and would not possibly cause anaemia.

The results of the effect of aqueous stem extract of *Pennisetum purpureum* (Achara) *on* haematological parameters shown in Table 7, indicated a significant decrease ($p<0.05$) in White Blood Cell (WBC) at 400mg/kg of diabetic treated animals. The significant reduction ($P < 0.05$) in WBC levels of diabetic rats treated with 400mg/kg of the plant extract when compared to the control and diabetic group gave credence to the abilities of the above treatment group in curtailing haematological abuses in the defence system of the diabetic rats since alloxan diabetogenesis may cause perturbation in the bone marrow stem cells (Edet *et al.,* 2011; Asanga *et al.,* 2013).

7. Conclusion

In conclusion, the present study demonstrates that the aqueous stem extract of *Pennisetum purpureum* (Achara)

possesses potential antidiabetic property at 400mg/kg of the plant extract and the abundance of this locally available plant with minimum cost, could replace to a great extend the use of costly diabetic drugs in Nigeria.

Acknowledgement

I would like to acknowledge the members of staff of the Department of Chemistry, Rivers State University of Science and Technology for their support, allowing me to use the departmental laboratory and also Chief Dr. B. G. Akuru's family for their financial support.

References

[1] Akter F., Rahman M. M., Mahbub M. and Emdadul H. C. (2014). Anti-diabetic Effect of Neem and Spirulina in Alloxan Induced Diabetic Mice. *International journal of Current research and AccademicReview.* 2(4): 124-134. ISSN: 2347-3215.

[2] AOAC. (1990). Official Methods of Analysis. 15th Edition. Association of Official Analytical Chemistry. Washington D. C., USA.

[3] Asanga E. E., Ebong E. P. and Eseyin, A. O. (2013). Hematological Parameters Of Alloxan-Induced Diabetic Rats Treated With Ethanol Extracts And Fractions Of Nauclea Lafiloia Leaf. E*uropean Scientific Journal.* vol. 9, No.27 pp 203-210. ISSN: 1857 – 7881.

[4] Bimlesh K., Harleen K. S., Sunil P., Prashant T., Manoj S. and Pardeep S. (2011). A Review of Phytochemistry and Pharmacology of Flavonoids. *Internationale Pharmaceutica Sciencia*. 1(1). 25-41.

[5] Cheesbrough M. (2005). Blood cell production. Distinct laboratory practice in tropical countries 2nd ed. Cambridge University United Kingdom.

[6] Dilip G. and Tetsuya K. (2007). Anthocyanins and anthocyanin-rich extracts: role in diabetes and eye function. *Asia Pacific Journal on Clinical Nutrition*; 16 (2): 200-208.

[7] Dilipkumar P. and Preeti V. (2013). Flavonoids: A Powerful And Abundant Source Of Antioxidants. *International Journal 0f Pharmacy And Pharmaceutical Sciences* .Vol 5, Issue 3, ISSN- 0975-1491.

[8] Dineshkumar B., Mitra A. and Manjunatha M. (2009). In vitro and in vivo studies of antidiabetic Indian medicinal plants: A review. *Journal of herbal medicine and toxicology.* 3. 9-14.

[9] Edet, E.E., Akpanabiatu, M. I., Uboh F. E., Edet T. E., Eno A. E., Itam E. H. and Umoh. I. B. (2011). *Gongronema latifolium* crude leaf extract reverses alterations in hematological indices and weight loss in diabetic rats. *Journal of pharmacology and Toxicology*, 6: 174-181.

[10] Elekofehinti O. O, Adanlawo I. G and Fakoya A. (2012). *Solanumanguivi* saponins inhibit basal erythropoiesis in *Rattusnovergicus*. *Asian Journal of Pharmaceutical and Health Sciences* www.ajphs.com Vol-2 | Issue-3.

[11] Emily L. (2005) Diabetes Mellitis: Type 1 and Type 2. *Guidelines For Adolescent Nutrition Services* Stang J, Story M (eds) Chapter 14 pg 167-182.

[12] Friedewald W. T., Levy R. I., Friedrickson D. S. (1972). Estimation of the concentration of low- density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*. 18:499-502.

[13] Hayes K.C, Khoisa P. and Pronezuk A. (1991). Diet-induced type IV-like hyperlipidemia And Increased Body weight. *Lipids.* 26(9):729-735.

[14] Ikewuchi C. C. (2012a). Hypocholesterolemic Effect Of An Aqueous Extract Of The Leaves Of *Sansevieria Senegambica* Baker On Plasma Lipid Profile And Atherogenic Indices Of Rats Fed Egg Yolk Supplemented Diet. *Experimental and Clinical Sciences International online Journal*. 11:318-327 – ISSN 1611-2156.

[15] Ikewuchi J. C. (2012b) Alteration Of Plasma Biochemical, Haematological And Ocular Oxidative Indices Of Alloxan Induced Diabetic Rats By Aqueous Extract Of *Tridax Procumbens* Linn (Asteraceae). *Experimental and Clinical Sciences International online Journal*. 11:291-308 – ISSN 1611-2156.

[16] Jack D. (2003) Overview of the Antidiabetic Agents. *Endocrine Pharmacotherapy Module* pg 1-33.

[17] Kumari M. and Jain S. (2012). Tannins: An Antinutrient with Positive Effect to Manage Diabetes. *Research Journal of Recent Sciences*. Vol. 1(12), 70-73, ISSN 2277-2502.

[18] Lee K. T, Shon I. C, Kim D. H, Choi J. W, Kwon S. H and Park H. J. (2000). Hypoglycemic and hypolipidemic effect of tectorigenin and kaikasaponin III in streptozotocin induced diabetic rats and their antioxidant activity in-vitro. *Archives of Pharmacal Research*. 23:461–6.

[19] Macabeo A. P. G. and Aguinaldo M. A (2008). Chemical and Phytomedicinal Investigations in *Lunasiaamara*. *Pharmacognosy Reviews*. Vol 2, Issue 4, Page 317-325.

[20] Malloy M. J. and Kane P. J. (2010). Agents Used in Dyslipidemia. Basic and Clinical Pharmacology. In Betram G. K., Masters S. B. and Trevor A. J. 12th Ed. Chapter 35. Pg. 619-633.

[21] Maqsood A., Zaman F. , Sharif T. and Zabta M. (2008). Antidiabetic and Hypolipidemic Effects of Aqueous Methanolic Extract of *Acacia Nilotica* Pods in Alloxan-Induced Diabetic Rabbits. *Scandinavian Journal of Laboratory Animal Science* Vol. 35 No. 1 pg 29-34.

[22] Maria-Luisa L. and Cristina F. (2013). Oxidative stress in diabtes mellitus and the role of vitamins with antioxidant actions. Agricultural and Biological Sciences. Chapter 9. 209-232.

[23] Munazza A., Aslam M. Munir T. A. and Nadeem A. (2011). Effect Of *Acacianilotica* Leaves Extract On Hyperglycaemia, Lipid Profile And Platelet Aggregation In Streptozotocin Induced Diabetic Rats *J Ayub Med Coll Abbottabad* 23(2) pp 3-5.

[24] Okaraonye C.C and Ikewuchi J. C. (2009). Nutritional and Antinutritional Components of *Pennisetum purpureum* (Schumach). *Pakistan Journal of Nutrition* 8 (1): 32-34 ISSN 1680-5194.

[25] Pandey, J. P., Tiwari, A., Mishra, G., and Mishra, R. M. (2011). Role of Spirulina maxima in the Control of Blood Glucose Levels and Body Weight in Streptozotocin induced Diabetic Male Wistar rats. *Journal of Algal Biomass Utilization.* 32 (4): 35 37.

[26] Sada N. M., Tanko Y and Mabrouk M. A. (2013). Effect of soya beans supplement on blood glucose levels and haematological indices on alloxan induced diabetic wistar rats. *Annals of Biological Research, 4 (2): 208-213.*

[27] Sheriff, D. S. (2004). Cholesterol metabolism. Medical Biochemistry 1st Ed. Chapter 25. pg. 192-198.

[28] Varley H., Gowenlook A. H. and Bell M. (1980). Practical Clinical Biochemistry. London: Heinemann Medical Books (I). pp. 1078-1092.

[29] Tripathi V. andVerma J. (2014). Different Models Used To Induce Diabetes: A Comprehensive Review. *International Journal of Pharmacy and Pharmaceutical Sciences.* Vol 6, Issue 6, 2014 pg 1-4 ISSN- 0975-1491.

[30] Vijayanand N., Sivasangari R. S., And Rathinave S. (2014). Antidiabetic Activity Of Cynodon Dactylon (L.) Pers. Extracts In Alloxan - Induced Rats. *International Journal of Pharmacy and Pharmaceutical Science.Vol 6, Issue 4, 348-352.*

[31] Yerima N.I, Anaka J. A., Salamu O.A and Abdu Aguye. (2013). Antihyperglycaemic activity of the stem bark extract of Tamarindusindica L. on Experimentally induced hyperglycaemic and normoglycaemic wistar albino rats. *Parkistan Journal of biology.* 17: 414-418.