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Original Research Article

Effect of ethanolic leaf extracts of *petersianthus macrocarpus* on Haematological Parameters and Lipid Profile of Streptozotocin Induced Type 2 Diabetic Wistar Rats

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Abstract: ***Background:*** The most prevalent kind of diabetes that results from insulin resistance is type 2. Hyperglycemia, polyphagia, polyuria, and polydipsia are the traditional trifecta of symptoms associated with this illness. The purpose of this study was to ascertain the impact of *petersianthus macrocarpus* ethanolic leaf extract on the lipid profile and haematological markers of streptozotocin-induced type 2 diabetic wistar rats. ***Materials and methods:*** Five groups of rats were used: non-diabetic, diabetic, untreated, glibenclamide-treated, ethanolic extract-treated, and 100 mg/kg body weight-treated. ***Results:*** The body weight of the rats treated with 100 mg/kg body weight increased, while the body weight of the rats treated with 50 mg/kg body weight decreased, according to the results. ***Conclusion:*** 100 mg/kg body weight was determined to be the least effective therapeutic dose, indicating the potential of ethanolic leaf extracts.

Keywords: Extract, lipid profile, diabetes, *petersianthus macrocarpus*, and streptozotocin.

INTRODUCTION

Diabetes mellitus is a common non-communicable disease majorly associated with hyperglycemia, which is a direct outcome of insulin resistance, insufficient insulin secretion, or excessive glucagon production. An autoimmune disease known as type 1 diabetes (T1D) causes the beta cells in the pancreas to be destroyed [1]. Insulin resistance and malfunctioning pancreatic beta cells combine to cause increasingly worse glucose regulation, which is the main cause of type 2 diabetes (T2D), which is far more prevalent [1]. Diabetes mellitus is a condition that knows no bounds; it appears when the kidneys produce excessive amounts of urine and the body is unable to regulate the quantity of glucose (a form of sugar) in the blood. It is caused by insufficient insulin production or improper insulin consumption [2]. Oral hypoglycemic medications and insulin are used to treat diabetes. The evergreen tree *Petersianthus macrocarpus* has a well-developed crown and a maximum height of 50 metres [3]. *Petersianthus macrocarpus* trees exhibit substantially enlarged bases in response to regular debarking in woods inhabited by elephants. Debarking promotes faster healing and lowers infection rates since the bark regrows from the wood's pores as well as the area around the wound [4]. In the southeast of Nigeria,

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traditional medicine frequently involved Petersianthus macrocaecythidaceae to treat infections and illnesses [5]. In traditional medicine, petersiathus macrocarpus stem bark is used to heal boils and pain in central and eastern Africa [6]. While numerous studies have examined the anti-malarial, anti-oxidant, anti-cancer, and gastroprotective properties of various extracts from *Petersianthus macrocarpus*, no research has been documented regarding the impact of the leaf extract on the lipid profile and haematological parameters of Streptozotocin (STZ)-induced diabetic rats.

Fig. 1: Image of *Petersianthus macrocarpus*

MATERIALS AND METHODS

Study location and duration

The study was conducted in the anatomy department at Madonna University Nigeria's Elele campus in Rivers State. Eight weeks total (2 weeks for acclimatisation and 6 weeks for bench work).

Research design

The design of the study was experimental and cross-sectional.

Sample population

Twenty-five (25) male wistar rats were used for the study. These rats were split up into five (5) distinct groups, each consisting of five (5) rats. Their weight ranged from 100 to 160g.

Eligibility criteria

Wistar Rats with Type 2 Diabetes Induced by Streptozotocin were included, while those that showed indications of abnormal haematological conditions such as polycythemia vera (PCV) and those that did not show an obvious indication of type 2 diabetes were excluded.

Sampling technique

Convenient sampling was used for the study.

Method of data collection

The *petersianthus macrocarpus* leaf used for the study was acquired from Imo State University Botanic Garden and identified at the Department of Plant Science and Biotechnology. The leaves were gathered and air dried for a duration of 21 days. After that, dry blending was done using a kenwood electronic blender into fine particles. 1.5 kilogramme of plant material in total was collected. Plant material weighing one thousand and fifty grammes (1050g) was extracted using a soxhlet method.

A round bottom flask that had been heated in a mantle burner nose - L12-11A filled with 2.5 litres of methanol. After filtration, the extract was recovered by evaporating it in a rotary evaporator at a temperature of around 40 degrees Celsius while operating at low pressure, and the semi-solid extracts were stored in a refrigerator for later use.

Streptozotocin was purchased from a Bridge Biotech (a pharmacy) in Ilorin, Kwara State, Nigeria, and used to induce diabetes. After an overnight fast, the animals were given an intraperitoneal injection of a newly made STZ solution (35 mg/kg body weight) in a 0.1M citrate buffer (pH 4.5) to induce diabetes. 72 hours following injection of streptozotocin, the amount of fasting blood glucose was measured. The rats received a second intraperitoneal injection of STZ (25mh/Kg b.w.) two weeks later. Blood sugar levels during fasting were also measured. Diabetic animals were defined as those whose fasting blood glucose level was 200 mg/dl or above.

Statistical analysis

The data was analyzed using Statistical Package for Social science Software (SPSS; version 20.0, USA). One-way analysis of variance (ANOVA) and Post hoc test were used to determine the mean difference and statistically significant values at $P<0.05$ of 95% confidence interval respectively. The result obtained were expressed as mean ± Standard Error Mean.

Ethical consideration

Ethical clearance was obtained from the Research Ethics Committee of Madonna University in Nigeria before the commencement of the study (REC.100/15 MU).

RESULTS

Table 1: Values of ethanolic leaf extract of Petersianthus Macrocapus on erythrocytes and its indices in STZ induced diabetic rats

GROUPS	RBC ($x10^{12}$/l)	PCV (%)	Hb (g/dl)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Normal	7.82 ± 0.20	44.15 ± 1.30	14.10 ± 0.11	56.45 ± 2.04	18.00 ± 13.00	31.90 ±0.02
Untreated Diabetic Rats	6.24± 0.09	34.80 ± 0.58[a]	11.25 ± 0.19	55.30 ± 2.53	18.20±03.50	31.80 ±0.02
Diabetic+Glib 0.5mg/kg	7.75± 0.40[b]	44.60 ± 1.31[b]	14.80 ± 0.12	57.60± 6.13	19.10 ± 06.41	33.20 ±0.11
Diabetic+PSM 50mg/kg	7.09 ± 0.22	41.30 ± 1.24[b]	13.00 ± 0.10	58.20 ± 3.09	18.35 ± 30.13	31.55 ±0.05
Diabetic+PSM 100mg/kg	7.12 ± 0.50	40.70 ± 1.24[b]	13.60 ± 0.23	57.20 ± 4.00	19.10 ± 17.03	33.40 ±0.22

The results on table 1, showed a reduction in red blood cell (RBC), packed cell volume (PCV), haemoglobin (Hb) and erythrocyte indices such as mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) (6.24± 0.09, 34.80 ± 0.58, 11.25 ± 0.19, 55.30 ± 2.53, 18.20±03.50, 31.80 ±0.02) of the untreated diabetic rats when compared to the control (5.03 ± 0.20, 42.05 ± 1.30, 15.03 ± 0.11, 83.80 ± 2.04, 32.32 ± 13.00, 38.28 ±0.02). At 0.5mg/kg, glibenclamide significantly increased ($p< 0.05$) RBC and PCV (7.75± 0.40, 44.60 ± 1.31) when compared to the untreated diabeticgroup (6.24± 0.09, 34.80 ± 0.58). At 50mg/kg, the extract significantly increased ($p<0.05$) PCV (41.30 ± 1.24) when compared to the untreated diabetic group (34.80 ± 0.58). At 100mg/kg, the extract caused a significant increase ($p<0.05$) in PCV (40.70 ± 1.24) when compared to untreated diabetic group (34.80 ± 0.58).

Table 2: Values of ethanolic leaf extract of Petersianthus Macrocapus on leukocytes and its differentials in STZ induced diabetic rats

GROUPS	TWBC ($x\ 10^9$)	Lymph (%)	Mono (%)	Neut (%)	Baso (%)	Eosin (%)	Platelets ($x\ 10^9$)
Normal	14.45 ± 1.00	71.80± 2.09	3.80 ± 0.12	18.50±0.00	0.40 ± 1.04	5.45 ± 0.09	285.00± 8.02
Untreated Diabetic Rats	10.35±0.08[a]	71.40±3.38	3.10± 0.50	21.85±0.00	0.25±1.02[a]	3.40±0.00[a]	221.20±1.05[a]
Diabetic+Glib 0.5mg/kg	8.30 ± 0.04	70.40 ±2.15	2.05 ± 0.22	22.35±0.20	0.30 ± 2.02[a]	4.90 ± 0.05	253.50±1.00[ab]
Diabetic+PSM 50mg/kg	12.35±4.80[b]	74.65±1.99[ab]	3.75±0.00	17.65±0.00[b]	0.15±0.15[ab]	3.80±0.26	230.50±5.11[ab]
Diabetic+PSM 100mg/kg	12.30±4.80[b]	72.80±1.99	4.30±0.08[b]	17.50±0.00[b]	0.70±2.25[ab]	4.70±0.04	267.22±0.61[ab]

The results on table 2 showed a significant decline ($p< 0.05$) in the white blood cell count (TWBC), basophil, eosinophil and platelets of the untreated diabetic group (10.35±0.08, 0.25±1.02, 3.40±0.00, 221.20±1.05) when compared to the control (14.45 ± 1.00, 0.40 ± 1.04, 5.45 ± 0.09, 285.00± 8.02). At 0.5mg/kg, glibenclamide significantly increased ($p< 0.05$) platelets (253.50±1.00) when compared to the untreated diabetic group (221.20±1.05). At 50mg/kg, the extract significantly increased ($p<0.05$) TWBC, lymphocytes, neutrophil, basophiles and platelets (12.35±4.80, 74.65±1.99, 17.65±0.000.15±0.153.80±0.26, 230.50±5.11) when compared to the untreated diabetic group (10.35±0.08, 71.40±3.38, 21.85±0.00, 0.25±1.02**,** 221.20±1.05). At 100mg/kg, the extract significantly increased ($p<0.05$) TWBC, monocytes, neutrophils, basophiles, and platelets (12.30±4.80, 3.10± 0.50,17.50±0.00, 0.70±2.25, 267.22±0.61) when compared to the untreated diabetic rats (10.35±0.08, 3.10± 0.50, 21.85±0.00, 0.25±1.02, 221.20±1.05).

Table 3: Values of ethanolic leaf extract of Petersianthus Macrocapus on lipid profile of STZ induced diabetic rats

GROUPS	HDL	LDL	TC	TG
Normal	1.40 ± 1.00	0.75± 2.09	2.50 ± 0.12	1.50±0.00
Untreated Diabetic Rats	1.20±0.08[a]	0.40±3.38[a]	2.25± 0.50	1.40±0.00
Diabetic+Glib 0.5mg/kg	1.20 ± 0.04	0.45 ±2.15	2.25 ± 0.22	1.25±0.20
Diabetic+PSM 50mg/kg	1.25±4.80	0.35±1.99	2.15±0.00[ab]	1.10±0.00
Diabetic+PSM 100mg/kg	1.40±4.80[b]	0.20±1.99[ab]	2.00±0.08[ab]	0.90±0.00[b]

At 0.5mg/kg, glibenclamideno significant changes (p>0.05) were observed in the lipid profile tested (1.20 ± 0.04, 0.45 ±2.15, 2.25 ± 0.22, 1.25±0.20) when compared to the untreated diabetic group (1.20±0.08, 0.40±3.38, 2.25± 0.50, 1.40±0.00).

At 50mg/kg, the extract significantly decreased (p<0.05) total cholesterol (TC) (2.15±0.00) when compared to the untreated diabetic group (2.25± 0.50).

At 100mg/kg, the extract significantly increased (p<0.05) high density lipoprotein (HDL) but decreased low density lipoprotein (LDL), total cholesterol (TC) and total triglyceride (TG) (1.40±4.800.20±1.99, 2.00±0.08, 0.90±0.00) when compared to the untreated diabetic rats (1.20±0.08, 0.40±3.38, 2.25± 0.50, 1.40±0.00).

DISCUSSIONS

Summary of results

There is a showed reduction in RBC, PCV, Hb and erythrocyte indices such as MCV, MCH and MCHC (6.24± 0.09, 34.80 ± 0.58, 11.25 ± 0.19, 55.30 ± 2.53, 18.20±03.50, 31.80 ±0.02) of the untreated diabetic rats when compared to the control (5.03 ± 0.20, 42.05 ± 1.30, 15.03 ± 0.11, 83.80 ± 2.04, 32.32 ± 13.00, 38.28 ±0.02). Values are presented as mean ± sem. n= 5. [a] = mean values are statistically significant compared to control, [b] = mean values are statistically significant compared to untreated diabetic group.

There is significant decline (p< 0.05) in TWBC, basophil, eosinophil and platelets of the untreated diabetic group (10.35±0.08, 0.25±1.02, 3.40±0.00, 221.20±1.05) when compared to the control (14.45 ± 1.00, 0.40 ± 1.04, 5.45 ± 0.09, 285.00± 8.02). The values were presented as mean ± sem. n= 5. [a] = mean values are statistically significant compared to control, [b] = mean values are statistically significant compared to UDR.

There was significant decline (p< 0.05) in HDL and LDL of the untreated diabetic group (1.20±0.08, 0.40±3.38) when compared to the control (1.40±1.00, 0.75±2.09).

Implications of the study

Blood glucose concentrations in the diabetic control group increased considerably, indicating that Streptozotocin (STZ) significantly damaged the pancreatic beta cells in that group. On the other hand, administration of an extract from Petersianthus macrocapus led to a considerable improvement in haematological HDL-C and a commensurate decrease in LDL. The visible ameliorative effect seen could be attributed to the potential of Petersianthus macrocapus to lower hyperglycemia and enhance antioxidant status. According to earlier research, Petersianthus macrocapus improves the absorption of glucose by the liver and skeletal muscle by enhancing the production of glycogen, which lowers blood glucose levels in these organs. Given the critical roles that both vitamin B12 and folic acid play in the development of red blood cells, Petersianthus macrocapus may have additionally increased the number of red blood cells by enhancing their absorption. Folic acid and vitamin B12 are necessary for erythroblasts to proliferate during their differentiation process. Nonetheless, the kidneys' production of erythropoietin (EPO) was increased by the injection of Petersianthus macrocapus, maybe as a result of the injury to the peritubular interstitial fibroblast cells. The elevated RBC count and other RBC indices could potentially have been explained by the improvement in EPO secretion. By reducing RBC agglutination and aggregation, we hypothesise that Petersianthus macrocapus's capacity to enhance haematological alterations may be linked to an improvement in cardiovascular hemodynamics [7].

The current study's results are consistent with those of Charity *et al.,* [8], who found that plant extract slows the development of cardiovascular problems in people with diabetes mellitus and reduces the haematological abnormalities brought on by hyperglycemia. Furthermore, it has been previously documented that naturally occurring triterpenoids, such as ursolic acid and glycyrrhizicacid, can ameliorate hyperglycaemic-induced abnormalities in haematological and lipid profile by reducing abnormally elevated blood glucose concentrations [9]. However, it has been demonstrated that diabetes increases the production of reactive oxygen species (ROS), which impairs RBC deformability and increases RBC hemolysis [10].

CONCLUSION

In STZ-induced diabetic rats, the current study shows the haematological and lipid efficaciousness of Petersianthus macrocapus, leading to an improvement in cardiovascular problems. The findings demonstrated that Petersianthus macrocapus lowers abnormally elevated high plasma glucose levels, potentially by increasing EPO secretion, boosting antioxidant status, lowering glycated haemoglobin, and enhancing cell survival over the course of the erythrocyte's lifetime. From the results of this study, giving diabetic patients ethanolic leaf extract of Petersianthus macrocapus may improve their lipid profile and blood counts.

Recommendation

To isolate the precise components generating the effects seen in this study, we advise finger printing the plant. Additionally, we suggest the chemical mechanism by which the Petersianthus macrocapus extract works.

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Declaration for conflict of interest: We declare that there is no conflict of interest.

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