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In alloxan-induced diabetic rats, the antidiabetic and hematological properties of *Triclisia subcordata* methanol extract were evaluated.

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ABSTRACT

Tricilisia subcordata has been used to treat a number of illnesses, so the effects of *T. subcordata* leaf methanol extract on hyperglycemia, hyperlipidemia, renal and hepatic abnormalities, as well as hematological indices in alloxan-induced diabetic rats, were examined. Rats were given alloxan to cause diabetic mellitus. For three weeks, the diabetic rats were given 100 mg/kg, 200 mg/kg, or 400 mg/kg of the *T. subcordata* extract. Weekly measurements were made of body weight and fasting blood glucose. We humbly sacrificed the rats. Analysis was done on the lipid profile, liver function, renal function, and hematological parameters. Methanol leaf extract of *T. subcordata* reduced weight loss and hyperglycemia in diabetic rats in a dose-dependent manner. *T. subcordata* lowered the elevated levels of liver enzymes and total cholesterol. The elevated creatinine levels in the serum were decreased by *T. subcordata*. This study shown that *T. subcordata* methanol leaf extract possesses hepatoprotective, renoprotective, antihyperglycemic, and antihyperlipidemic effects in alloxan-induced diabetic rats.

Key words: Diabetes mellitus; Hyperlipidemia; Hyperglycemia; Hematological indices; Kidney; Liver

1. Introduction

Diabetes mellitus, often known as chronic metabolic disease, is still a major global health concern. Over the past few decades, there has been a steady rise in the occurrence of this illness. Numerous factors, including obesity, sedentary activity, and unhealthy lifestyles, have been found to contribute to its prevalence. It is predicted that the number of people with diabetes mellitus would increase from 536.6 million in 2021 to 783.2 million by 2045 (Sun et al., 2022).

This condition is associated with greater rates of morbidity and mortality due to its detrimental economic impact, especially in developing countries. Despite the availability of many treatment classes, patients with diabetes mellitus nevertheless confront many challenges, including undesirable side effects, prohibitive pricing, and limited accessibility. These problems, together with unmet expectations and insufficient effectiveness, have led to an increase in interest in complementary and alternative therapies for the management of diabetes mellitus (Erejuwa, 2014).

Triclisia is a flowering plant that belongs to the Ranunculales order and the Menispermaceae family, respectively. It has roughly 24 species, *T. subcordata* included. Among other African countries, Guinea, Nigeria, and Angola are where it is mostly found. This therapeutic herb is called "tietie" in Nigeria. It grows well in some temperate areas and in West African tropical and subtropical regions. It is referred to as Gwanda in Hausa, Ibepe in Yoruba, and Ojo Mgbimgbi in Yoruba (Watanabe et al., 2016). The plant is called Ogwu-aju (anti-dizziness treatment) in Nsukka and Ezize (benevolent skin development) in Ohafia due to its fibrous ascending stem, and Ike Mbekwu, which indicates that the turtle's anal area at Umuoji is based on its morphology. It's commonly used for tying applications as a rope. This plant has a variety of medicinal applications. According to Ologunisola and Fadahunsi (2017), *T. subcordata* is claimed to provide a wide range of health advantages, including hepatoprotective, anticancer, anti-infertility, antibacterial, antimalarial, anticonvulsant, antilipidemic, and antianemic properties. Unfortunately, many of the purported health benefits remain unverified. Additionally,

there is a local legend that this plant may benefit those who suffer from diabetes mellitus. However, there's no scientific proof to support this theory. Thus, in alloxan-induced diabetic albino rats, this study examined the effects of *T. subcordata* leaf methanol extract on alloxan-induced diabetic albino rats' hepatic enzymes, creatinine, hematological indices, hyperglycemia, and hyperlipidemia.

2. Materials and Methods

Plant material collection

In the late afternoon or early evening, *T. subcordata* fresh leaves were harvested in Ebonyi State, Nigeria. A taxonomist from the University of Nigeria's Department of Botany in Nsukka, Nigeria, identified and authenticated the plant. A voucher specimen, designated UNNH 58, was placed in the University of Nigeria's herbarium located in Nsukka, Nigeria. Triclisia subcordata Oliv., Fl. Trop. Afr. [Oliver et al.] 1: 49 (1868) is listed in the International Plant Names Index.

Plant extraction

After being allowed to dry at room temperature, the *T. subcordata* leaves were ground into a fine powder. Using a stirring rod, 300g of *T. subcordata* leaf powder was macerated in 1.5 liters of 99.9% methanol for a full day. A muslin cloth (sieve) was then used to extract the filtrate after the mixture had been violently agitated. In order to preserve the metabolites, the filtrate was lastly dried in a water bath at a lowered temperature of 40 oC.

Phytochemical analysis

The phytochemical analysis of the methanol extract of *T. subcordata* leaf was conducted using the method described by Mathews and colleagues (Mathews et al., 2016).

Chemicals

Among them were glibenclamide, methanol (Sigma, Germany), diethyl ether, normal saline, and alloxan (Sigma-Aldrich, MO, USA). Analytical grades applied to all other reagents.

Animals

The study's animals were obtained from the Ebonyi State University Abakaliki animal house. The University Research Ethics Committee of Ebonyi State University, Abakaliki, granted ethical permission (EBSU/DRIC/UREC/Vol.04/057).

Study of acute toxicity

Using the Organization for Economic Co-operation and Development's (OECD) Guidelines for the testing of chemicals, an oral acute toxicity test was conducted on the methanol extract of *T. subcordata* (OECD, 2010). We utilized male rats weighing 180–220 g. There were two stages of the test. Phase 1 involved the oral administration of 500, 1000, and 2000 mg/kg of *T. subcordata* extract methanol extract to three groups of three rats each. After then, the rats were watched for indications of toxicity and death for a full day, paying close attention to the first four hours. The second step (the phase 2 test) came next. Phase 2 involved the oral administration of 3000, 4000, and 5000 mg/kg of *T. subcordata* extract methanol extract to three groups of three rats each. We kept an eye out for symptoms of poisoning in the rats, like hyperactivity, salivation, paw-licking, writhing, paralysis of the muscles, respiratory trouble, and death. Each group's death toll was noted, and the LD50 value was calculated.

Induction of diabetes mellitus

36 male albino rats weighing 180-200 g were procured and acclimatized in Foxgloves animal house. The animals were placed on animal pellets and water *ad libitum*. Diabetes mellitus was induced by intraperitoneal administration of alloxan (150 mg/kg BW) dissolved in normal saline.

Another group of rats was injected with normal saline without alloxan. 72 hours after alloxan administration, blood glucose was measured in overnight fasted rats using an Accu-chek glucometer (Roche, Germany). Animals with blood glucose levels of 250 mg/dL and above were considered diabetic and randomly divided into five groups. Another set of normal rats served as group 1 and represented the non-diabetic control.

Handling

Group 1: Distilled water (1 ml/kg) was given to normal rats.
Group 2: Drinking water (1 ml/kg) was given to diabetic rats induced by alloxan.
Group 3: 100 mg/kg of extract was given to diabetic rats caused by alloxan.
Group 4: 200 mg/kg of extract was given to diabetic rats caused by alloxan.
Group 5: 400 mg/kg of extract was given to diabetic rats caused by alloxan.
Group 6: Glibenclamide (0.6 mg/kg) was given to diabetic rats caused by alloxan.

The 21-day treatment period started on the same day. Glibenclamide was dissolved in regular saline, but the extract was dissolved in drinking water. Using an oral cannula, all of the drugs were given to the rats orally in accordance with the previously described treatment regimen. Rats were measured for body weight before to treatment. Subsequently, BW and fasting blood glucose were assessed every week and at the study's conclusion. The rats were given medication for 21 days, fasted throughout the entire night, and then sacrificed with diethyl ether. Biochemical markers such as total cholesterol, triglycerides (TG), high density lipoproteins (HDL), alanine transaminase (ALT), aspartate transaminase (AST), and alkaline phosphatase (ALP) were measured on blood samples, albumin, and creatinine) on the EMP-168 Biochemical Analyzer in accordance with the manufacturer's instructions using Agappe kits (Agappe Diagnostics, Switzerland). The Friedewald equation, which reads LDL cholesterol = Total cholesterol - [HDL cholesterol + (TG/5)] was used to determine serum low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) cholesterol. Friedewald and associates, 1972. TG/5 = VLDL cholesterol. Commercially available kits were also utilized to measure the hematological parameters.

AnalyticalStatistics

The mean ± SEM is used to express data. STATA version 20 was used to analyze the data. One-way analysis of variance (ANOVA) was used to assess the results, and the Tukey post hoc test was used to identify differences between the two groups. It was deemed statistically significant when $P < 0.05$.

3. Results

Acute toxicity effect

The rats showed no symptoms of toxicity, morbidity, or mortality after consuming the extract. The rats had normal poo consistency, were in good health, and were fed well. *T. subcordata's* methanol leaf extract had a lethal dose (LD50) of more than 5000 mg/kg body weight.

Phytochemical determination

Alkaloids and glycosides were the most common secondary metabolites in the methanol extract of *T. subcordata,* according to the results of the phytochemical investigation. Flavonoids, saponins, and reducing sugars came next. There were also trace amounts of terpenoids, steroids, tannins, phlobatannins, and resins among the other metabolites. The findings also showed that the *T. subcordata* methanol extract lacked anthraquinone.

Effects of *T. subcordata* on percentage change in body weight and blood glucose

Table 1 displays the findings on *T. subcordata's* impact on the percentage changes in blood glucose and body weight. Rats with diabetes control group experienced a considerably ($p < 0.05$) less percentage change in body weight than rats without diabetes. The percentage change in body weight was significantly ($p < 0.05$) improved in diabetic rats treated with *T. subcordata* (100 or 200 mg/kg). When compared to diabetic control rats, the treatment of diabetic rats with T. subcordata (200 or 400 mg/kg BW) significantly ($p < 0.01$) decreased the percentage change in blood glucose.

T. subcordata effect on liver and renal functions

Table 2 presents the results of T. subcordata's impact on liver and renal function markers. When *T. subcordata* (100 mg/kg) was administered to diabetic rats, the level of serum albumin rose significantly ($p < 0.05$) in comparison to the diabetic control group. When compared to diabetic control rats, the administration of *T. subcordata* (200 or 400 mg/kg) or glibenclamide to diabetic rats resulted in a significant ($p < 0.05$) decrease in blood ALP and creatinine levels.

Effect of _T. subcordata_ on lipid profile

Table 3 presents the findings on *T. subcordata's* impact on lipid profile parameters. The tables demonstrate that, in comparison to non-diabetic control rats, total cholesterol, triglycerides, and LDL cholesterol were considerably ($p < 0.05$) higher in diabetic control rats. When compared to the levels of diabetic control rats, the administration of *T. subcordata* (100 mg/kg) considerably ($p < 0.05$) decreased the levels of total and LDL cholesterol in the diabetic rats.

Effect of _T. subcordata_ on hematological parameter

Table 4 presents the findings on *T. subcordata's* impact on hematological parameters. According to the table, there was a substantial ($p < 0.05$) decrease in PLT and PCT between diabetic control rats and non-diabetic control rats. *T. subcordata* (200 or 400 mg/kg) treatment shielded diabetic rats from decreased PCT and PCT levels.

Table 1: *T. subcordata's* effects on the percentage changes in the blood glucose and body weight of diabetic rats

Treatment	% Change in body weight (%)	% Change in blood glucose (%)
Non-diabetic control (1 ml/kg DW)	22.6 ± 2.4	-7.3 ± 11.1
Diabetic control (1 ml/kg DW)	-18.6 ± 2.4***	-9.5 ± 9.1
T. subcordata (100 mg/kg)	7.9 ± 3.4 †††	-39.7 ± 11.3
T. subcordata (200 mg/kg)	-3.0 ± 4.2***, †	-59.9 ± 7.9**, ††
T. subcordata (400 mg/kg)	-7.7 ± 4.6***	-72.7 ± 6.1**, ††
Glibenclamide (0.6 mg/kg)	-11.6 ± 3.0***	-59.3 ± 10.5*, †

Values are expressed as mean ± SEM. Each group consisted of 5 rats
* P < 0.05, ** P < 0.01 & *** P < 0.001 compared with Non-diabetic control
† P < 0.05, †† P < 0.01 & ††† P < 0.001 compared with Diabetic control
DW= Distilled water

Table 2: Impact of *T. subcordata* on diabetic rats' liver and kidney functions

Treatment	Albumin (mg/dL)	ALT (mg/dL)	AST (mg/dL)	ALP (mg/dL)	Creatinine (mg/dL)
Non-diabetic control (1 ml/kg DW)	3.9 ± 0.1	54.1 ± 16.6	94.2 ± 15.7	442.3 ± 42.2	2.30 ± 0.28
Diabetic control (1 ml/kg DW)	3.3 ± 0.1*	99.4 ± 23.4	229.3 ± 50.8	2898.4 ± 502.1 ***	3.51 ± 1.14
T.subcordata (100 mg/kg)	3.9 ± 0.3 †	70.5 ± 11.9	175.8 ± 73.3	1619.1 ± 286.9	1.37 ± 0.28
T. subcordata (200 mg/kg)	3.5 ± 0.1	89.9 ± 24.6	198.9 ± 36.5	1367.4 ± 367.3 †	0.53 ± 0.09 ††
T. subcordata (400 mg/kg)	3.7 ± 0.2	93.3 ± 27.7	186.4 ± 28.4	931.7 ± 261.3 ††	0.78 ± 0.29 †
Glibenclamide (0.6mg/kg)	3.6 ± 0.1	115.0 ± 40.3	203.2 ± 70.7	1341.1 ± 412.6 †	0.93 ± 0.44 †

Values are expressed as mean ± SEM. Each group consisted of 5 rats
* $P < 0.05$, *** $P < 0.001$ compared with Non-diabetic control rats
† $P < 0.05$, †† $P < 0.01$ compared with Diabetic control rats
ALT: Alanine transaminase, AST: Aspartate transaminase, ALP: Alkaline phosphatase,

DW= Distilled water

Table 3: *T. subcordata's* impact on the lipid profile of rats with diabetes

Treatment	Total cholesterol (mg/dL)	Triglycerides (mg/dL)	HDL cholesterol (mg/dL)	LDL cholesterol (mg/dL)	VLDL cholesterol (mg/dL)
Non-diabetic control (1 ml/kg DW)	38.7 ± 6.1	33.5 ± 4.9	4.7 ± 0.6	33.1 ± 4.6	7.0 ± 1.1
Diabetic control (1 ml/kg DW)	76.9 ± 2.3**	48.3 ± 2.9*	4.4 ± 1.1	62.9 ± 1.3*	9.2 ± 0.6
T. subcordata (100 mg/kg BW)	42.9 ± 6.7 †	50.9 ± 2.8*	5.7 ± 1.2	31.2 ± 8.1 †	10.6 ± 0.5*
T. subcordata (200 mg/kg)	44.7 ± 8.5 †	45.0 ± 2.4	5.9 ± 1.6	38.7 ± 9.9	10.5 ± 0.4*
T. subcordata (400 mg/kg)	65.4 ± 6.4*	47.3 ± 0.8	6.6 ± 0.7	54.2 ± 5.1	9.5 ± 0.2
Glibenclamide (0.6mg/kg)	78.5 ± 3.6**	38.2 ± 4.4	7.5 ± 0.5	62.5 ± 4.7	9.4 ± 0.6

Values are expressed as mean ± SEM. Each group consisted of 5 rats

* P < 0.05, ** P < 0.01 compared with Non-diabetic control rats

† P < 0.05 compared with Diabetic control rats

HDL: High density lipoprotein, LDL: Low density lipoprotein, VLDL: Very low density lipoprotein

DW= Distilled water

Table 4: Effect of *T.subcordata* on hematological parameters of diabetic rats

	Non-diabetic control (1 ml/kg DW)	Diabetic control (1 ml/ kg DW)	*T. subcordata* (100 mg/kg)	*T. subcordata* (200 mg/kg)	*T. subcordata* (400 mg/kg)	Glibenclamide (0.6mg/kg)
WBC x 10^9/L	4.48 ± 0.37	3.99 ± 0.57	4.86 ± 0.78	5.44 ± 0.96	3.58 ± 0.93	3.65 ± 0.27
LYM x 10^9/L	3.55 ± 0.29	2.97 ± 0.53	3.38 ± 0.66	3.78 ± 0.65	2.66 ± 0.71	2.60 ± 0.18
MID x 10^9/L	0.30 ± 0.05	0.29 ± 0.04	0.42 ± 0.07	0.46 ± 0.11	0.30 ± 0.08	0.32 ± 0.05
NEUT x 10^9/L	0.63 ± 0.12	0.73 ± 0.05	1.06 ± 0.17	1.20 ± 0.27	0.62 ± 0.15	0.73 ± 0.13
RBC x 10^{12}/L	6.69 ± 0.17	6.21 ± 0.56	6.91 ± 0.15	6.84 ± 0.13	6.84 ± 0.29	6.52 ± 0.15
HGB (g/dL)	14.15 ± 0.34	13.83 ± 1.26	15.42 ± 0.51	14.82 ± 0.29	15.08 ± 0.68	14.3 ± 0.47
HCT (%)	39.73 ± 0.96	37.76 ± 2.57	42.04 ± 1.25	40.36 ± 1.00	39.78 ± 2.04	39.08 ± 0.62
MCV (fL)	59.53 ± 0.68	62.59 ± 3.22	60.16 ± 0.54	59.08 ± 0.73	58.20 ± 0.83	60.10 ± 1.00
MCH (pg)	21.12 ± 0.20	22.29 ± 0.25	22.00 ± 0.35	21.64 ± 0.34	22.00 ± 0.57	21.88 ± 0.53
MCHC (g/dL)	35.57 ± 0.21	36.11 ± 1.41	36.64 ± 0.46	36.70 ± 0.70	38.00 ± 1.37	36.52 ± 0.77
RDW-SD (fL)	33.12 ± 0.89	41.70 ± 6.58	35.28 ± 2.12	33.44 ± 1.85	29.72 ± 0.59	31.90 ± 2.00
RDW-CV (%)	14.42 ± 0.29	16.80 ± 1.54	15.20 ± 0.93	14.64 ± 0.76	13.24 ± 0.37	13.70 ± 0.64
PLT x 10^9/L	961.0 ± 76.6	459.6 ± 57.1**	583.8 ± 64.4*	626.2 ± 96.5	693.3 ± 118.1	464.0 ± 109.3**
PCT (%)	0.92 ± 0.07	0.43 ± 0.05**	0.54 ± 0.06*	0.57 ± 0.09	0.70 ± 0.12	0.44 ± 0.10**
MPV (fL)	9.62 ± 0.14	9.36 ± 0.15	9.32 ± 0.17	9.16 ± 0.15	9.18 ± 0.28	9.52 ± 0.11
PDW (%)	12.65 ± 0.38	11.79 ± 0.53	11.02 ± 0.70	10.92 ± 0.31	11.12 ± 0.88	10.78 ± 0.50
P-LCR (%)	28.30 ± 1.60	27.11 ± 1.68	25.58 ± 1.53	24.54 ± 1.52	24.16 ± 2.57	28.95 ± 1.29

Values are expressed as mean ± SEM. Each group consisted of 5 rats

* $P < 0.05$ & ** $P < 0.01$ compared with Non-diabetic rats + Drinking water

WBC: White blood cells, LYM: Lymphocytes, MID: Mid-range absolute count, NEUT: Neutrophils, RBC: Red blood cells, HGB: Hemoglobin, HCT: Hematocrit test, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular, hemoglobin concentration, RDW-SD: Red cell distribution width – standard deviation, RDW-CV: Red cell distribution width – coefficient of variation, PLT: Platelets, PCT: Plateletcrit

DW= Distilled water

4. Discussion

The diabetic control rats in this study developed hyperglycemia, or high blood glucose, when they were left untreated. A popular medication for causing diabetes in animals is alloxan (type 1 diabetes mellitus). It has been observed that rats treated with alloxan at a dose of 150 mg/kg BW develop chronic hyperglycemia (Erejuwa et al., 2016; Bunza and Dallatu, 2017). Hyperglycemia that develops after alloxan administration is a sign of pancreatic β-cell destruction brought on by alloxan. Hyperglycemia results from decreased insulin secretion, or insulin deficit. When compared to the diabetic control rats that were not given any medication, the diabetic rats treated with *T. subcordata* showed noticeably lower blood glucose levels. This suggests that *T. subcordata* has antihyperglycemic or hypoglycemic effects, which may be related to the plant's abundance of bioactive compounds. It has been shown that a number of secondary metabolites, including glycosides and alkaloids, have antihyperglycemic or hypoglycemic properties (Akuodor et al., 2021; Bharti et al., 2018; Palasz et al., 2019).

One common symptom of diabetes brought on by alloxan is weight loss. The diabetic control rats lost the most weight out of all the groups. The results of earlier research (Erejuwa et al., 2016; Mans and Aburjai, 2019) are in line with this. Increased skeletal muscle proteolysis and adipose tissue lipolysis are the main causes of weight loss in people with diabetes mellitus (Mans and Aburjai, 2019; Pamela and Richard, 1994). In diabetic rats, *T. subcordata* at a dose of 100 mg/kg inhibited weight loss. The abundance of secondary metabolites in *T. subcordata* may help explain why it resists weight loss.

Creatinine levels were higher in the diabetes control rats than in the non-diabetic control rats. Normally, the kidneys are used to eliminate creatinine. However, when the kidneys are compromised or injured, creatinine builds up in the blood (Kandeel et al., 2011). Renal impairment is thus indicated by the higher creatinine level seen in diabetic control rats. *T. subcordata* treatment (particularly 200 or 400 mg/kg) significantly lowered creatinine levels in diabetic rats. This implies that *T. subcordata* may have a protective effect against renal impairment brought on by diabetes. Compared to non-diabetic rats, the albumin concentration was significantly lower in the diabetic control rats. Other researchers (Erejuwa et al., 2016; Akuodor et al., 2018; Schlatzer et al., 2012) observed a similar finding. Reduced blood albumin in diabetic rats may be the result of glomerular membrane damage-related leaking via the kidney (Erejuwa et al., 2012). When *T. subcordata* was given to diabetic rats, the albumin levels were

returned to those of the rats without diabetes. This provides more support for *T. subcordata*'s renoprotective benefits in diabetic rats.

Hepatic enzyme levels (AST, ALT, and ALP) were markedly raised in the serum of the diabetic control rats. These outcomes agree with earlier research. Usually found only in the hepatic cells, these hepatic enzymes are involved in the metabolism of amino acids. But these enzymes leak out of the liver cells into the bloodstream after hepatic injury or liver toxicity, which causes them to build up in serum (Gumral et al., 2021). Thus, diabetes-induced hepatocellular damage is indicated by the higher levels of these liver enzymes in the serum of untreated diabetic rats. The significantly higher ALP activity in diabetic rats that are left untreated is noteworthy. This enzyme is specifically located in the hepatic bile duct and is thought to be a sign of cholestasis, hepatic function, and biliary function (Gumral et al., 2021). The high concentrations of these enzymes were reduced by the extract's administration. This implies that *T. subcordata* has a hepatoprotective effect on diabetic rats.

Hypercholesterolemia and hypertriglyceridemia were among the lipid abnormalities seen in the untreated diabetic rats. This agrees with earlier research results (Sivakumar et al., 2019). Diabetes mellitus is commonly associated with changes in lipid levels. Insulin insufficiency, or decreased insulin levels, is mostly to blame for this. One anabolic hormone is insulin. Therefore, hypertriglyceridemia, hypercholesterolemia, and other lipid disorders are linked to its shortage (Uehara et al., 2023). Some of these lipid measures, particularly total cholesterol and LDL cholesterol, were returned to non-diabetic rats after treatment with *T. subcordata*. These results suggest that *T. subcordata* can help diabetic rats with dyslipidemia. The impact of the plant extract on hematological parameters was also investigated in this study. When compared to the rats without diabetes, the diabetic control group had anomalies in most of the hematological parameters that were measured. These results align with those of Bunza and associates, who documented hematological irregularities in rats with diabetes (Bunza and Dallatu, 2017). The significantly lower platelet (PLT) and PCT levels in untreated diabetic control rats are particularly noteworthy. The significance of the PLTs in blood coagulation is acknowledged. They also have a major part in acute phase reactions to inflammation and in the healing of blood vessel walls. In a dose-dependent way, *T. subcordata* treatment stopped the decrease of PLT and PCT. This implies that there might be some positive benefits of this extract on hematological disorders.

When compared to the diabetic control rats, the glibenclamide-treated diabetic rats had a noticeably lower percentage change in blood glucose. A prior study had shown a similar finding (Erejuwa et al., 2016). The well-known antidiabetic drug glibenclamide causes the remaining beta cells to secrete more insulin. When compared to diabetic control rats, glibezine did not significantly alter the percentage of body weight in the diabetic rats. Although the exact cause of glibenclamide's failure to stop weight loss in diabetic rats is unknown, prior research has indicated that the drug stopped weight loss in streptozotocin-induced diabetic rats (Cheng et al., 2013); nevertheless, other research revealed no such impact (Erejuwa et al., 2021).

Glibenclamide did not significantly raise albumin or HDL cholesterol in diabetic rats given the medication in a prior study (Erejuwa et al., 2011). Similar results were found in this investigation. In this investigation, the increased levels of creatinine, triglycerides, ALP, and total cholesterol in diabetic rats were not reduced by glibepenclamide. These outcomes are in contrast to earlier research that demonstrated glibenclamide reduced triglycerides and total cholesterol in diabetic rats. (Erejuwa et al., 2011). The variations in glibenclamide's sources may be the cause of the discrepancy in glibenclamide's effects between these two investigations. While the glibenclamide utilized in the Erejuwa et al. investigation was acquired from Sigma-Aldrich, M.O., USA, the glibenclamide used in this study was obtained from a local pharmacy in Abakaliki, Ebonyi State, Nigeria.

5. Conclusion

In alloxan-induced diabetic rats, this study showed that *T. subcordata* methanol leaf extract has antihyperglycemic, antihyperlipidemic, hepatoprotective, and renoprotective properties.

Conflict of interest

The authors declare absence of conflict of interest in this research work.

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