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RESEARCH ARTICLE

PHYTOCHEMICAL SCREENING AND ANTIDIABETIC ACTIVITY OF METHANOLIC EXTRACT OF *CAYLUSEA ABYSSINICA* LEAVES

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Abstract

Introduction: Controlling type 2 diabetes with a treatment having no side effects remains a challenge for researchers even if the side effects are reduced and there may be a chance for reduced adverse reactions or severe side effects due to drug interaction. These interactions could result from concurrent use of dietary supplements or pharmacological therapy in addition to the medications. The current reading's objective was to assess the qualitative and quantitative phytochemical analyses, and antidiabetic potentials of methanol leaf extract of *Caylusea abyssinica* (*C. abyssinica*) in diabetic rats.

Methods: The qualitative and quantitative phytochemical analyses of total alkaloids phenol, and flavonoids were determined using the well-known test procedure outlined in the literature. The obtained *C. abyssinica* methanol leaf extract was used to examine *in vitro* anti-diabetic activity (α-Amylase inhibition), oral acute toxicity, and in vivo anti-diabetic activity against streptozotocin-induced diabetes rat model. Alkaloids, carbohydrates, reducing sugars, saponins, phenolic compounds, glycosides, tannins, and flavonoids were all established in the samples after phytochemical examination.

Results: The amount of phenolics in the methanol leaf extract was (295.50 mg/g), with flavonoids coming in second (136.66 mg/g) and alkaloids coming in third (11.23 mg/g). The extract's ability to inhibit α-amylase was investigated. The study's findings show that the chosen plants had significant in vitro anti-diabetic effect. Up to 2000 mg/kg given over 14 days, the methanol extract's acute toxicity trials did not reveal any harmful effects. Rats were given streptozotocin (60 mg/kg; i.p.) to induce diabetes, and glibenclamide (500 mcg/kg body weight) was utilized as the usual medication. Body weight, HDL, total protein, SGOT, SGPT, cholesterol, blood sugar levels, and triglycerides were all assessed in this study. Comparing diabetic rats to normal (control) rats, blood sugar and total protein, SGOT, SGPT, cholesterol levels, and triglyceride concentrations were all considerably ($p<0.001$) reduced after oral administration of methanol extract of *C. abyssinica* at doses of 100 and 200 mg/kg and increased the level of HDL and body weight.

Conclusion: As a result of the aforementioned findings, it can be said that *C. abyssinica* methanol leaf extract significantly reduces blood sugar levels in streptozotocin-induced diabetic rats.

Keywords: *Antidiabetic* activity, α- Amylase inhibition, *Caylusea abyssinica*, Glibenclamide, Phytochemical analysis, Streptozotocin.

INTRODUCTION

Diabetes mellitus is the primary basis of, blindness, renal failure, strokes, lower limb and heart attacks amputations in adults around the world. In most developed countries, it ranks as the fourth leading cause of mortality. According to the International Diabetes Federation, 330 million people worldwide are expected to have diabetes by the year 2025, with Africa and Asia potentially experiencing the biggest increases. Developing nations will see this numerical growth. By 2025, more than 75% of diabetes would reside in

developing countries, up from 62% in 1995[1]. Diabetes is treated using insulin as well as a number of oral antidiabetic drugs such glinides biguanides, and sulfonylureas. One of the key areas of research is the hunt for more powerful and secure hypoglycemic agents because many of them have a lot of major side effects[2]. Orally consumed herbs and plants by experimental animals have been said to have hypoglycemic properties[3,4,5]. According to the WHO, more than 1200 plant species are used to treat diabetes mellitus worldwide, and a sizable number of these plants shown beneficial hypoglycemic action during laboratory testing[6]. Certain medicinal plants have recently been shown to be effective in treating diabetes worldwide and have been empirically used in anti-hyperlipidemic[7] and anti-diabetic therapy. Finding new anti-diabetic drugs made from natural plants is still intriguing even if there are more than 400 plant species with hypoglycemic activity described in literature. This is because these plants include chemicals that have various and safe effects on diabetes mellitus. Alkaloids, terpenoids, glycosides, carotenoids, and flavonoids, among other compounds, are present in the majority of plants and well acknowledged to have antidiabetic properties[8]. However, research into plants hypoglycemic, antioxidant, and hypolipidemic, qualities may lead to the creation of fresh pharmaceutical treatments for the treatment of diabetes mellitus[9]. Streptozotocin (STZ) one of the most widely used diabetogenic drugs is, an antibiotic produced by *S. achromogenes* that is inexpensive and has few side effects. When coupled with nicotinamide (NA), it is used to cause both type 1 and type 2 diabetes[10]. Pancreatic cells are highly selectively poisonous to it. The hexose moiety, which aids it in crossing the cell membrane via GLUT2[11], is responsible for selectivity. DNA is alkylated by STZ by the transfer of the CH_3 group to the DNA particle, which fragments the DNA and contributes to its toxicity. This excessively activates poly (ADP-ribose) polymerase-1 (PARP-1), which reduces cellular NAD+ (the substrate of PARP), ATP, and ultimately leads to beta cell necrosis. This plant primarily rises between 1500 and 2750 metres above sea level in open grasslands, meadows, byways, and rocky regions. It is found throughout Northern and Eastern Africa as well as the Mediterranean region. The plant is widespread in some Eastern African countries, including Kenya, Uganda, Rwanda, Burundi, Tanzania, Malawi, Sudan, and Ethiopia[12]. For instance, in Ethiopia, and Tanzania its leaves and stems are eaten alone or as vegetables. People who live in the places where the plant grows are also familiar with using it as medicine. Its leaves are used to cure amoebiasis, diabetes mellitus, and skin conditions. Similar to this, its roots are used to treat erectile dysfunction, diarrhoea from Scabies, and gastrointestinal pain in people[13]. The effectiveness of *C. abyssinica* crude extracts against several human ailments has been the subject of some investigation. There have been reports of certain chemicals being isolated from various morphological areas of the plant[14]. The leaves of *C. abyssinica* have been shown to contain saccharopine [(2S, 2′S)-N6- (2-glutaryl) lysine], 2-aminoadipic acid and several-glutamyl peptides[15]. The aim of this study was to assess the quality (types), quantity (amount), and antidiabetic potential of the methanolic extract of *C. abyssinica* leaves in diabetic rats[16].

MATERIALS AND METHODS

Plant material

Fresh undamaged leaf and fruit samples were harvested from several parts of the innermost canopies of fruiting plants from Emene, Enugu, Enugu State Nigeria in June, 2022.

Extraction

Plant material fattening

Plant matter from *C. abyssinica* was crushed up and allowed to air dry at ambient temperature. Soxhlation was used to remove the substance from the shade-dried plants using petroleum ether after it had been coarsely crushed up. The substance was extracted repeatedly until it had been adequately fatted.

Extraction by soxhlation process

C. abyssinica powder that has been defatted was thoroughly extracted with methanol using the soxhlation process. The extract evaporated beyond their boiling points. The dried crude concentrated extract was weighed in order to calculate the extractive yield. When ready for analysis, it was then put into glass vials (6 x 2 cm) and stored in a refrigerator (4 °C).

Phytochemical screening

According to the protocols described, phytochemical screening was done to find any bioactive compounds. By visually seeing a colour change or the production of precipitates following the addition of specific reagents to the solution, the tests were recognized[17].

Total phenol measurement

The Folin Ciocalteu reagent was employed to calculate the total phenolic substance of the extracts. Gallic acid concentration (20-100 µg/ml) was produced in CH_3OH. 100 µg/ml plant extract concentrations were likewise made in CH_3OH, and 0.5 ml of every sample was added to the test along with 4 ml of 7.5% sodium carbonate and 2 ml of a 10 fold diluted folin Ciocalteu reagent. After parafilming the tubes, they were keep warmed at RT for 30 minutes with periodic shaking. The absorbance at 765 nm was calculated against CH_3OH as a vacant. Gallic acid's conventional regression curve was utilized to calculate the content of phenol overall, and the results were given in milligrammes per gramme (mg/gm) of gallic acid.

Total flavonoids measurement

Rutin (20 to 100 µg/ml) was produced in CH_3OH at various concentrations. Test samples with a polarity of 100 µg/ml or close to it were created. A sample was diluted to 0.5 ml and then added to 0.15 ml of a 5% $NaNO_2$ solution along with 2 ml of distilled H_2O. A 10% $AlCl_3$ solution was added after 6 minutes had passed. The combination was then given 5 minutes to stand before receiving 2 ml of a 4% NaOH solution. With distilled water, the final volume was adjusted to 5ml, and then it was left to stand for an additional 15 minutes. At 510 nm, the absorbance was calculated using H_2O as the reference. Rutin's standard regression

curve was employed to calculate the whole flavonoid substance[18].

Total alkaloids measurement

Dimethyl sulphoxide (DMSO) was employed to liquefy the plant extract (1 mg), and then 1 ml of 2 N HCl was added and drinkable. This solution was reassigning to a separating funnel, and then 5ml of phosphate buffer and 5 ml of bromocresol green solution were included. The mixture was vigorously agitated with 1, 2, 3, and 4 ml $CHCl_3$ before being collected in a 10 ml volumetric flask and $CHCl_3$ was added to dilute to the volume. Atropine reference standard solutions ranging from 50 to 250 µg/ml were created. The absorbance of the test and standard solutions in relation to the reagent blank at 470 nm was measured using a UV/Vis spectrophotometer. Mg of AE/g of extract was used to express the overall alkaloid content[19].

***In-vitro* Anti-diabetic activity**

α- Amylase inhibition activity

Polysaccharides like starch, carbohydrates, and other polysaccharides are metabolized by the alpha amylase enzyme. Four test tubes containing a prepared (1:1) amylase solution were used. 1 cc of the solution was taken from the test tube above and kept in another test tube for testing. Four rows, one for each tube, of two drops of iodine solution were placed in the spot plate. This is then combined with 0.5 cc of 1% starch solution. The first tube received a drop of solution right away, while the second tube received a second drop of solution one minute later. The sampling was carried out every min waiting every starch had been broken down and the tube's colour had turned light brown or vanished. Because large concentrations of amylase will digest the starch quickly and provide results, amylase concentration increases along with a corresponding rise in response rate and a corresponding decline in reaction time. As the concentration of the medication grows, so does the time it takes for a reaction, therefore glibenclamide was used as a standard and methanolic extracts of *C. abyssinica* served as an amylase inhibiting agent[20].

Animals

Wistar rats (180–250 g) were residence in groups of six (n=12) under regulated humidity and temperature settings (25±2°C, 55-65%). Rats were given regular rodent food and unlimited amounts of water. Prior to the experiments, rats spent 7 days becoming used to the lab environment. Between 8:00 and 15:00 hours, all studies were conducted in a room with no background noise. Each set of studies used a different group of rats (n=6)[21].

Acute oral toxicity

According to Organization for Economic Co-Operation and Development (OECD) Guidelines-423, an acute toxicity investigation of the produced extracts was conducted. Animals were starved for 4 hours, but were given unrestricted access to water during that time. The beginning dose level should, in accordance with OECD standards, be the one that will most likely result in animal mortality in some of the dosed animals. When this information regarding a chemical being tested is not yet available, one of three fixed starting dose levels 5, 50, 300, or 2000 mg/kg body weight is chosen[21].

Induction of experimental diabetes in rats

Six rats were placed in each of the different groups of separated animals. After an overnight fast, group II-V received an IP injection of STZ at a dose of 60 mg/kg body weight, melted in 0.1 M sodium citrate buffer at pH 4.5. (Divest of food for 16 hours but agreed unrestricted access to H_2O). The identical quantity of 0.1 M sodium citrate buffer was given to the control rats. To treat the hypoglycemia brought on by drugs, over the duration of the night, the animals had admission to 5% glucose solution to drink. By assessing blood glucose levels 72 hours after STZ injection, diabetes status was established. The study only included animals with levels of fasting blood sugar more than 250 mg/dl. Rats' body weight was recorded by an electronic balance on the first and last days of post-treatment, or pre- and post-treatment. Rats' fasting blood sugar levels were checked before and after the treatment, or on the eighth and twenty-first days following treatment.

In the current investigation, 5 groups of 5 rats every containing 6 animals were used.

Group I: Normal

Group II: Diabetes management only received STZ (negative control)

Group III: Received Glibenclamide orally for 14 days at a dose of 500 mcg/kg body weight.

Group IV: Diabetes-prone rats were given *C. abyssinica* leaf extract in methanol (100 mg/kg/day p.o.)

Group V: Diabetes-prone rats were given 200 mg/kg/day of *C. abyssinica* leaf extract in methanol.

Taking blood samples and measuring blood sugar

To assess blood glucose, blood was drawn using the tail-snipping technique. Blood was taken from a heart puncture, which is an appropriate approach for estimating various lipid profiles and biochemical markers. All through the research period, blood samples from all the (16–20 hours) overnight-fasted animals were taken in plain micro centrifuge tubes every other week while they were under anaesthesia. Centrifugation was used to extract the serum from the blood sample for 10 minutes at 4000 rpm. The automated biochemistry analyzer Hitachi-902 was used to study biochemical parameters[22].

Estimation of oral glucose tolerance test

In the presence of glucose oxidize, oxygen and glucose combine to form gluconic acid and hydrogen peroxide. The dyes turn blue when H_2O_2 oxidizes them in a mechanism mediated by peroxide reductases. However, it was found that the glucometer was acceptable for diagnosing conditions in terms of test accuracy, requiring only a drop of blood to obtain results, and being simple to use at temperatures above 95°F. It was utilized in place of the customary and drawn-out process of other diagnostic kits[23].

Statistical analysis

The mean and SEM were employed to state all the data. One-way analysis of variance was employed to evaluate the groups' statistical implication before

Dunnett's t-test post-hoc analysis. *p* values below 0.5 were regarded as noteworthy.

RESULTS

After completing each consecutive soxhlation extraction process, the crude extracts were focused on a bath of water by totally evaporating the solvents to achieve the real extraction capitulate. Petroleum ether and methanol were found to produce extracts from plant portions called leaves with yields of 2.56 and 9.51%, respectively. Table 1 shows the results of a qualitative phytochemical analysis of the raw leaves of *C. abyssinica.* Alkaloids, reducing sugars, saponins, phenolic and steroidal chemicals, glycosides, tannins, and flavonoids were all detected in methanolic plant extracts, whereas protein and carbohydrates were detected in petroleum ether extracts[24]. Calculating the total phenolic content in milligrammes of gallic acid equivalents per 100 milligrammes of dry sample weight. The percentage of rutin equivalent per 100 mg dry weight of sample used to represent the percentage of total flavonoids in the extracts. The percentage of atropine equivalent per 100 mg dry weight of sample used to express the total amount of alkaloids present in the extracts.

Table 1: Results of extract phytochemical screening of *C. abyssinica.*

S. N.	Test	Result	
		Petroleum ether Extract	Methanolic Extract
1	Flavonoids	-ve	+ve
2	Alkaloids	-ve	+ve
3	Phenolic compounds	-ve	+ve
4	Saponins	-ve	+ve
5	Tannins	-ve	+ve
6	Carbohydrates	+ve	-ve
7	Anthraquinone glycosides	-ve	-ve
8	Reducing sugars	-ve	+ve
9	Cardiac glycosides	-ve	+ve
10	O-anthraquinones	-ve	-ve
11	Steroidal compounds	-ve	+ve
12	Protein	+ve	-ve

Table 2: Analysis to determine the amount of phenolics, flavonoids, and alkaloids in plant extract.

Plants	Total phenolic content (mg/gm equivalent of gallic acid)	Total flavonoid content (mg/gm equivalent of rutin)	Total alkaloid content (mg/gm equivalent of atropine)
C. abyssinica	295.50	136.66	11.23

The *C. abyssinica* plant's methanol extract has a high level of total phenolic and flavonoid content (Table 2). Since there is a high concentration of α-amylase present, the starch will be broken down quickly, as the concentration of α-amylase rises, so does the pace of reaction (Table 3). As glibenclamide concentration rises, the time it takes for a reaction to take place likewise rises because there are insufficient amounts of the enzyme molecules needed to break down starch (Table 4). The current work focuses on how methanolic extracts of *C. abyssinica* inhibit α-amylase. Increase in reaction time, or the time required by α-Amylase to digest the starch, is a sign that an extract has α-amylase inhibitory activity. According to the observations, the time it takes for a reaction to occur grows as the concentration of the extract does as well, however they are less active than regular medications. As the concentration of α-amylase rises, the rate of reaction likewise rises while the time of reaction decreases because a high concentration of amylase will swiftly digest the starch[25]. The methanolic extracts of *C. abyssinica* were observed to have α-amylase inhibitory activity, but this activity was determined to be less than that of a conventional medication (Table 5). Up to 2000 mg/kg, the methanolic extracts of *C. abyssinica* did not exhibit any mortality or adverse events. As a result, the study was conducted at doses of 100 and 200 mg/kg[26]. When compared to the control mice throughout the research, the diabetic animals displayed a considerable loss in body weight. However, *C. abyssinica* methanol extract plus glibenclamide prevented the body weight loss caused by diabetes Table 6. On day 0 and day 21, the average diabetic control group's blood sugar level was 290.40±7.20 mg/dl and 405.20± 10.20mg/dl, respectively.

Table 3: Control tube of amylase solution.

S. N.	Amylase Solution	Buffer Solution (pH 6.8)	Time Until Starch Diffuse
1	1 ml tube+ 0.5 ml starch sol^n+ 2% amylase sol^n	20 drops	17
2	1 ml tube+ 0.5 ml starch sol^n+ 1% amylase sol^n	20 drops	13
3	1 ml tube+ 0.5 ml starch sol^n+ 0.5% amylase sol^n	20 drops	10
4	1 ml tube+ 0.5 ml starch sol^n+ 0.25% amylase sol^n	20 drops	7

Table 4: Observation of standard drug (Glibenclamide) on α-amylase inhibition.

S. N.	Amylase Solution	Buffer Solution (pH 6.8)	Time Until Starch Diffuse
1.	1 ml tube+ 0.5 ml starch sol^n+ 2% amylase sol^n+ 2% std^n drug sol^n	20 drops	13
2.	1 ml tube+ 0.5 ml starch sol^n+ 1% amylase sol^n+ 1% std^n drug sol^n	20 drops	18
3.	1 ml tube+ 0.5 ml starch sol^n+ 0.5% amylase sol^n+ 0.5% std^n drug sol^n	20 drops	21
4.	1 ml tube+ 0.5 ml starch sol^n+ 0.25% amylase sol^n+ 0.25% std^n drug sol^n	20 drops	24

Table 5: Observation of methanolic extracts of *C. abyssinica* on α-amylase inhibition activity.

S. N.	Amylase Solution	Buffer Solution (pH 6.8)	Time Until Starch Diffuse
1	1 ml tube+ 0.5 ml starch sol^n+0.25 ml amylase sol^n+ 0.25% Extract	20 drops	11
2	1 ml tube+ 0.5 ml starch sol^n+ 0.5 ml amylase sol^n+ 0.5% Extract	20 drops	16
3	1 ml tube+ 0.5 ml starch sol^n+ 1 ml amylase sol^n+ 1% Extract	20 drops	20
4	1 ml tube+ 0.5 ml starch sol^n+ 2 ml amylase sol^n+ 2% Extract	20 drops	21

On the other hand, as compared to the diabetic control group, the methanol extract of *C. abyssinica* at 100 mg/kg and 200 mg/kg considerably (p<0.001) lowered the fasting blood serum glucose level in the diabetic rats on the 7th, 14th, and 21st days.

The serum glucose level was shown to be dramatically decreased by the widely used medication glibenclamide, returning it to a level that was close to normal. The results are shown in Table 7. At the conclusion of the experiment, the levels in the treatment group were still within normal ranges while those in the diabetic rats' blood lipid profiles dramatically (p<0.001) rose when compared to the control animals, with the exception of HDL. Table 8 shows the impact of glibenclamide and a methanol extract of the *C. abyssinica* plant on the lipid profile of diabetic pigs[27]. Total protein levels in diabetic mice were significantly lower than in control animals, although levels were normal and total protein in *C. abyssinica* and glibenclamide-treated animals. Table 9 shows the effects of glibenclamide and *C. abyssinica* methanol extract on the liver and kidney indicators of diabetic rats.

DISCUSSION

An essential technique in the investigation of bioactive compounds is the phytochemical screening test. The process is easy, rapid, and affordable, and it provides the researcher with an immediate response to the many phytochemical kinds included in a mixture. Due to the presence of numerous components that are essential for good health, these phytochemicals looked to have the potential to serve as a source of helpful medications and to improve the health condition of the consumers.

Table 6: Effect of plant methanol extract of the *C. abyssinica* on body weight in rats.

Group	Drug and Dose	Body Weight (gm)	
		Initial weight (gm)	Final weight (gm)
I	Normal control (Saline)	189.00±8.70	205.00±9.17
II	Diabetic control (STZ)	199.00±9.0	167.00±8.300
III	STZ+ glibenclamide	193.10±8.60	212.00±9.60*
IV	STZ+ *C. abyssinica* 100mg/kg	173.00±7.60	209.00±910*
V	STZ+ *C. abyssinica* 200 mg/kg	171.00±8.50	206.00±9.00*

The results of a qualitative phytochemical analysis of *C. abyssinica* leaves that were not treated are shown in Table 1. The human digestive tract contains a variety of enzymes that aid in food digestion. α-amylase catalyses the conversion of polysaccharides into mono-saccharides, because the stomach can only absorb foods in their monosaccharide form. It is well known that the digestive tract quickly breaks down starch into glucose. Shortly after consuming starch, a pronounced hyperglycemia that results in hyperinsulinemia is seen. Both of these undesirable processes in the patient's GIT are caused by the α-amylase enzyme, which is distributed throughout the GIT and is in charge of the metabolism or digestion of starch and carbohydrate into glucose molecules[28].

The methanolic extracts of *C. abyssinica* were observed to have α-amylase inhibitory activity, but this activity was determined to be less than that of a conventional medication (Table 3- Table 5). The OECD criteria were followed when conducting the toxicity studies. Up to 2000 mg/kg, the methanolic extracts of *C. abyssinica* did not exhibit any mortality or adverse events. As a result, the study was conducted at doses of 100 and 200 mg/kg.

Table 7: Effect of plant methanol extract of the *C. abyssinica* on serum glucose level in rats.

Group	Drug and Dose	Serum glucose levels (mg/dl)		
		0 Day	8th Day	21th Day
I	Normal Control (Saline)	69.20±2.65	84.300±3.20	105.10±6.02
II	Diabetic Control (STZ)	289.40±6.20	386.00±8.65#	404.20± 9.20#
III	STZ+ Glibenclamide	258.00±6.30	128.10±5.40*	109.00±6.80*
IV	STZ+ *C. abyssinica* 100 mg/kg	263.00±5.25	129.00± 6.90	118.00±5.90*
V	STZ+*C. abyssinica* 200 mg/kg	260.00±4.00	128.20±6.40*	115.00±4.00*

The mean ±S.E.M. of the values is used (n = 6). At $p < 0.05$, values are statistically significant. (One-way ANOVA is used first, then Dunnett's test.)

Table 8: Effect of plant methanol extract of the *C. abyssinica* on serum lipid profiles i.e. total cholesterol, triglyceride, HDL, LDL level in rats.

Group	Drug and Dose	Total Cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
I	Normal Control	141. 80±4.7	111.10±3.50	48.40±1.37	74.45±5.65
II	Diabetic Control	246.55±8.4	213.30±4.60	28.09±1.30	177.09±5.55
III	STZ+ Glibenclamide	186.09±4.41***	131.40±5.20***	45.80±1.34***	87.00±5.89***
IV	STZ+*C. abyssinica* 100 mg/kg	198.61±7.00**	151.54±3.38*	40.39±1.54**	114.20±5.55**
V	STZ+ *C. abyssinica* 200 mg/kg	193.07±8.2***	149.09±3.48**	40.27±1.45***	105.34±5.12***

The mean ±S.E.M. of the values is used (n = 6). At $p<0.05$, values are statistically significant. (One-way ANOVA is used first, then Dunnett's test.)

A gram-positive bacterium called *S. achromogenes* produces the poisonous glycoside known as STZ. Through the glucose transporter 2 (GLUT2), it builds up in pancreatic cells and lowers their expression. Insulin-dependent diabetes is brought on by the alkylating activities of the STZ, which alter biological macromolecules, break up DNA, and kill cells[29]. The diabetes control group saw a considerable decrease of body weight, which may be due to an increase in muscle wasting and a loss of tissue proteins[24,30]. In the current investigation, the treatment groups significantly reduced their body weight, which suggests that glibenclamide and methanolic extracts of *C. abyssinica* stop the muscle loss caused by hyperglycemia. Increased plasma insulin levels or improved blood glucose transport in peripheral tissue may be to blame for the drop in glucose levels[26,27]. Current findings demonstrate that methanolic extracts of *C. abyssinica* increase plasma insulin levels and have potential anti-diabetic effects. The STZ-induced diabetic hyperglycemia increases plasma levels of SGPT and SGOT, which are important indicators of liver impairment.

Table 9: Effect of plant methanol extract of the *C. abyssinica* on total protein, SGPT, SGOT (U/L), SALP (U/L) in rats.

Group	Drug and Dose	Total Protein (g/dl)	SGPT(U/L)	SGOT(U/L)	SALP(U/L)
I	Normal Control	4.6±5.10	55.00±3.56	40.73±3.77	139.24±3.45
II	Diabetic Control	14.4± 2.5	134.10±3.30	132.15±3.00	297.89±4.00
III	STZ+ Glibenclamide	5.0±3.00***	76.15±4.20***	54.57±3.00***	164.20±3.00***
IV	STZ+ *C. abyssinica* 100 mg/kg	6.5±3.60**	98.02±4.72**	82.98±2.87*	197.88±4.50
V	STZ+ *C. abyssinica* 200 mg/kg	5.30±5.00***	83.14±3.19**	68.10±2.70**	180.43±4.00**

The mean ±S.E.M. of the values is used (n = 6). At $p < 0.05$, values are statistically significant. (One-way ANOVA is used first, then Dunnett's test.)

This might be because the different biomarkers found in the methanolic extracts of *C. abyssinica* have hepatoprotective properties[28]. In STZ diabetic rats, there are more lipid peroxides and reactive oxygen species, which cause hyperglycemia. The continual generation of free radicals might harm tissue through the peroxidation of unsaturated fatty acids[29,30].

CONCLUSIONS

In order to find and screen the phytochemical components that are essential for the creation of novel medications, medicinal plants are used. Due to the existence of the phytochemical elements, the results of the current study and the prior phytochemical examination are remarkably similar. The anti-hyperglycemic properties of *C. abyssinica* leaves extract were comparable to those of the standard medication used in this investigation; this might be brought about by a rise in insulin producti on from the pancreatic beta cells that have grown again and a reduction in α-amylase. Through a rise in HDL cholesterol, the plant also demonstrated cardio protective effects. The outcomes of this research, however, support the plant's conventional use in the management of diabetes.

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AUTHOR'S CONTRIBUTION

Al-Kaf AG: Conceived idea, data collection, data analysis. **Nelson NO:** methodology, investigation. **Patrick OU:** Literature survey, analysis of data, review. **Peace AN:** Manuscript initial drafting, data interpretations. **Victor EJ:** Literature survey. **Okolie**

SO: writing original draft, lab work. **Alexander I:** methodology, investigation. All the authors approved the finished version of the manuscript.

DATA AVAILABILITY

Data will be made available on reasonable request.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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