Research Article

Phytochemical compositions, and hypoglycemic effect of methanol leaf extract of *Telfairia Occidentalis* in alloxan-induced diabetic rats

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Abstract

Background: The use of medicinal plants for the treatment of diabetes is increasing due to several reasons such as safety, affordability and efficacy. In the present study, the phytochemical compositions and hypoglycemic effect of the methanol leaf extract of *Telfairia occidentalis* (ML-TO) were investigated. **Methods:** Phytochemical screening was conducted using standard methods. Fifteen rats were divided into 5 groups (n=3). Diabetes was induced in rats allocated to groups A-D using alloxan monohydrate (120 mg/kg BW) and was treated with 200 and 400 mg/kg BW ML-TO, 5 mg/kg BW glibenclamide and 5 ml/kg BW normal saline respectively. All treatments were administered orally, once daily for 29 days. **Results:** The results revealed that the ML-TO contains phenols, alkaloids, tannins, steroids, glycosides while flavonoids and saponins were not detected. Quantitatively, total phenols (9570±13.24 µg/mg) was the most abundant phytochemicals identified while tannins (3000.56±23.45 µg/mg) and alkaloids (0.2378±0.013µg/mg) were also present in appreciable amount in ML-TO. The extract produced a significant (p <0.05) and dose-dependent hypoglycemic effect with maximum activities occurring at 400 mg/kg BW having suppressed the fasting blood glucose levels from 334±33.62 to 137±37.31 mg/dL while the rats treated with 200 mg/kg BW lowered blood glucose level from 386±171 to 174±108.55mg/dL. The standard antidiabetic drug (Glibenclamide) produced a comparable hypoglycemic effect and suppressed the FBS from 350±169.74 to125±76.35 mg/dL. **Conclusion:** ML-To had a significant hypoglycemic effect and was able to ameliorate the weight loss in the diabetic rats, hence it could serve as a source of potential hypoglycemic agent

Keyword: *Telfairia occidentalis; Diabetes mellitus; hypoglycemia; body weight; fasting blood sugar*

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1.0 Introduction

Diabetes mellitus (DM) is a common metabolic disease associated with increased morbidity and mortality and can be defined as a group of diseases characterized by chronic hyperglycemia, due to defective insulin secretion, insulin action or both, resulting in impaired carbohydrate, protein and lipid metabolism[1,2]. It is a chronic disease caused by inherited or acquired deficiency in insulin secretion and by decreased responsiveness of the organs to secreted insulin, such a deficiency results in increased blood sugar levels, which can damage many of the body's systems, including blood vessels and nerves [3,4].

The growing number of diabetics, coupled with the side effects of some synthetic drugs [5,6] has led to the increasing search for alternatives, which are relatively cheap with minimal or no side effects [7]. One therapeutic approach for treating diabetes is to decrease the post-prandial (i.e. after meal) hyperglycemia. This is done by reducing the absorption of glucose through the inhibition of the carbohydrate-hydrolysing enzymes α-glucosidase and α-amylase in the digestive tract[8]. These enzyme inhibitions delays carbohydrate digestion and prolong overall carbohydrate digestion time, causing a reduction in the rate of glucose absorption and consequently blunting the postprandial plasma glucose rise [9].

African medicinal plants serve as a reservoir for bioactive agents for the treatment of various diseases[10-14]. Many natural resources have been investigated with respect to the suppression of glucose production from carbohydrates in the gut or glucose absorption from the intestine[15]. Studies have confirmed the benefits of medicinal plants with hypoglycaemic effects in the management of diabetes mellitus [16]. The effects of these plants may delay the development of diabetic complications and correct the metabolic abnormalities [17]. Moreover, during the past few years, some of the new bioactive drugs isolated from hypoglycaemic plants showed antidiabetic activity with more efficacy than oral hypoglycaemic agents used in clinical therapy[18].

Telfairia occidentalis Hook f. commonly called fluted pumpkin is well grown in West Africa as a leaf vegetable and also for its edible seed [19]. It occurs in the forest zone of West and Central Africa, most frequently in Benin, Nigeria and Cameroon [20]. The stems have branching tendrils and the leaves are divided into 3– 5 leaflets. The fruits are pale green, 3 – 10 kg in weight, strongly ribbed at maturity and up to 25cm in diameter. The seeds are 3– 5cm in diameter [20]. The leaf is consumed in different parts of the country because of the numerous nutritional and medicinal attributes ascribed to it [21].

Traditionally, the plant has been reportedly used for the treatment of various diseases including convulsion, gastrointestinal disorders, malaria and anaemia[22,23]. The plant has also been reported for various biological activities including, anticancer and anti-inflammatory [24], antioxidant [25], hepatoprotective [26], antimalarial [27], haematopoietic enhancer [28,29], insecticidal [30], immunomodulatory[24] among others. It is clear that many biological activities have been reported for *Telfairia occidentalis,* however, little attention has been placed on the antidiabetic potential of the leaf extract of this plant. In order to bridge the gap in knowledge, the present study was set out to evaluate the phytochemical compositions and hypoglycaemic effect of the methanol leaf extract of *Telfairia occidentalis* in alloxan-induced diabetic rats

2.0 Methods

2.1 Plant Sample Collection

The leaves of *Telfairia occidentalis* was collected from the Chanchaga local government area of Minna, Niger State, Nigeria. The plant was identified and authenticated by a Botanist at the Department of Biological Science, Federal University of Technology, Minna, Nigeria.

2.2 Plant Preparation and Extraction.

The plant was rinsed under clean running water, air-dried, and pulverized. The powdered sample was stored in an airtight container until it is ready for use. Five hundred gram (500 g) of powdered plant materials was extracted with 2.0 liters of absolute methanol using a reflux extractor. The crude extract was concentrated using a rotary evaporator. The concentrated extract was stored in a refrigerator at 4 °C.

2.3 Experimental animals

Adult albino rats weighing 121.35±2.09 g were obtained from the animal house of the University of Jos, Nigeria. Animals were kept under standard laboratory conditions. All animals handling and experimentations were in compliance with the principles governing the use of laboratory animals as laid out by the Federal University of Technology, Minna Committee on Ethics for Medical and Scientific Research as contained in the Animal Care Guidelines and Protocol Review of National Institutes of Health Guide for the Care and Use of Laboratory Animals (NIH Publication No. 85-23, 1985).

2.4 Analysis of phytochemical analysis

The qualitative and quantitative phytochemical composition of the crude methanol extract were conducted using established protocols. The tannin content of the plants was determined using the Folin Denis reagent, and tannic acid as the standard [31]. The total flavonoid contents was estimated using a spectrophotometer based on the formation of a flavanoid-aluminum complex that absorbs maximally at 415 nm [32]. Total phenol was estimated using Folin-Ciocalteu reagent protocol [33]. The total alkaloids were quantitatively estimated spectrophotometrically at 565 nm using vincristine as standard [34]. A gravimetric method of AOAC [35], was used for saponin determination in the samples.

2.5 Induction of diabetes

The diabetic was induced in the experimental rats according to the methods described by

Etuk, [36]. Overnight fasted rats were injected with 120 mg/kg BW freshly prepared alloxan monohydrate intraperitoneally. The blood glucose level of the rats was checked after 72hours of induction and animals with FBG ≥ 200 mg/kg BW were considered diabetic.

2.6 Determination of Fasting Blood Sugar

The samples of blood were collected from the tail of the rat at an interval of 2 days. Blood glucose level was estimated using an Achu-check glucometer with its commercial test strips based on the glucose oxidase method.

2.7 Animals grouping and Treatment

Fifteen (15) albino rats were divided into 5 groups (A-E) of 3 animals each. Diabetes was induced in mice allocated to groups A-D were treated with 200 and 400 mg/kg BW of the crude methanol leaf extract of *Telfairia occidentalis*, 5 mL/kg BW distilled water (negative control) and 5mg/kg BW glibenclamide (standard control) respectively while group J was set up as normal control and received 5 mL/kg BW distilled water without induction of diabetes. All treatment was administered orally for 29 days.

2.8 Total Body Weight

The body weights of the experimental rats were determined on 2 days' interval using an electronic weighing balance and the percentage weight loss or gain was computed

2.9 Data analysis.

All analysis was conducted in triplicate and analyzed using statistical package for social science (SPSS) version 16 and presented as means ± standard error of the mean. One-way analysis of variance (ANOVA) at $p < 0.05$ were used for comparing the significant differences between treatment groups.

3.0 Results

3.1 Phytochemical Composition of the methanol leaf extract of *Telfairia occidentalis* (ML-TO)

The qualitative and quantitative phytochemical composition of the methanol leaf extract of *Telfairia occidentalis* is shown in table 1: the crude methanol leaf extract of *Telfairia occidentalis* contains phenols, alkaloids, tannins, steroids, glycosides but flavonoids and saponins were not detected. Quantitatively, the total phenols represent the most abundant secondary metabolite identified in methanol leaf extract of *Telfairia occidentalis* having a concentration of 9570±13.24 µg/mg, while tannins occur at the concentrations of 3000.56±23.45 µg/mg. The alkaloid was found at the concentration of 0.2378±0.013µg/mg in the crude methanol leaf extract of *Telfairia occidentalis*

Table 1: Phytochemical composition of *T. occidentalis* leaf extract

Phytochemicals	Inference	Concentration (µg/mg)
Total flavonoids	-	ND
Total phenol	+	9570.67±13.24
Alkaloids	+	0.2378±0.01
Tannins	+	3000.56±23.45
Steroids	+	ND
Glycosides	+	ND
Saponins	-	ND

Key:+;presence, -; absence, ND; not detected

3.2 Hypoglyceamic effect of methanol leaf extract of *Telfairia occidentalis*

The fasting blood glucose level of alloxan-induced diabetic rats treated with methanol leaf extract of *Telfairia occidentalis* is shown in figure 1: The diabetic untreated rat shows a continuous and significant increase in blood glucose level when compared with the normal control and other experimental groups. Administration of methanol leaf extract of *Telfairia occidentalis* produces a dose-dependent and progressive decrease in blood glucose level when compared with the untreated group. However, the decrease in blood glucose level produced by the extract is lower compared to the decrease in blood glucose level observed with standard drugs (glibenclamide).

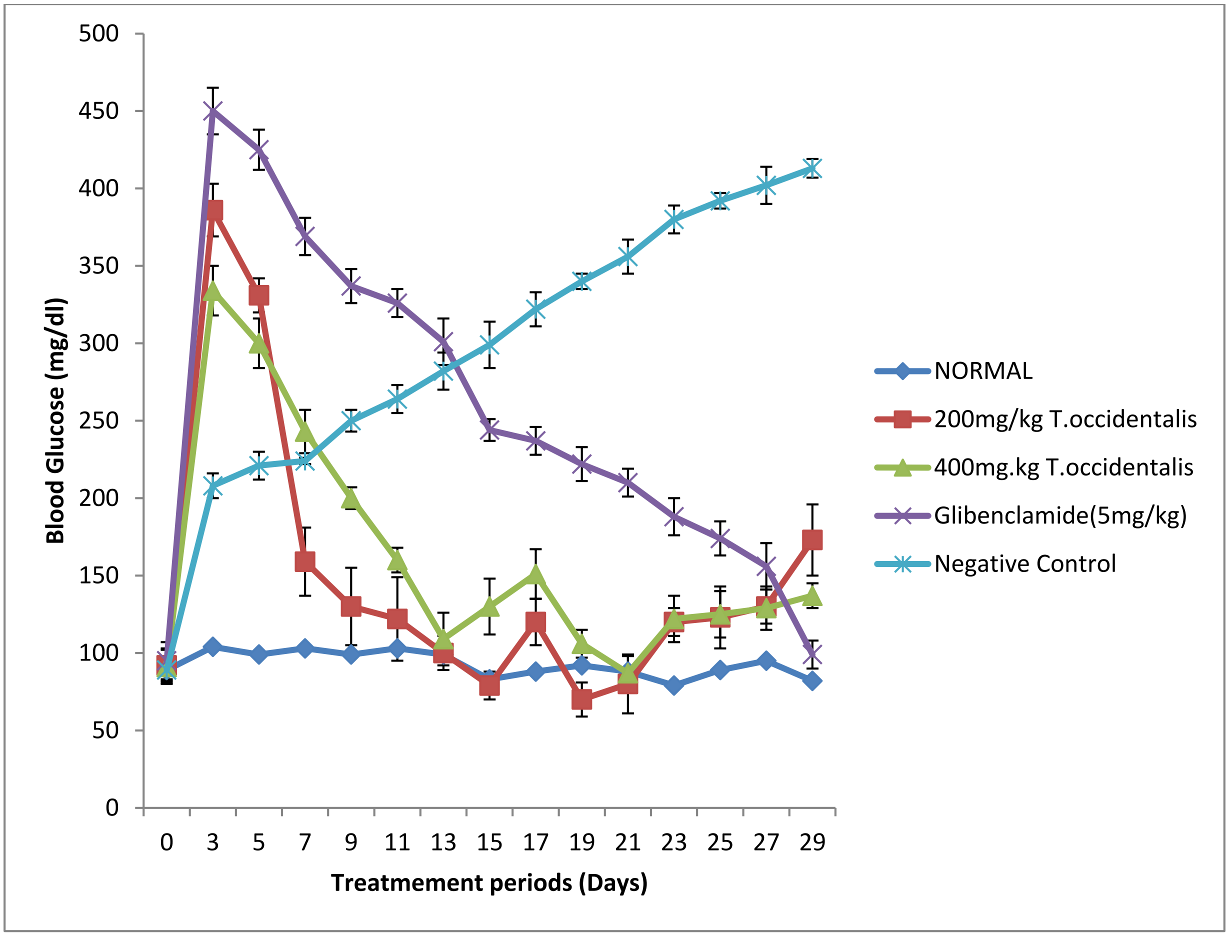

Figure 1: Hypoglycaemic effect of *T. occidentalis* in alloxan induced diabetic rats. Each bar point represents MEAN±SEM of triplicate determinations

3.3 Effect of methanol leaf extract of *Telfairia occidentalis* on body weight of diabetic rats

The ameliorative effect of methanol leaf extract of *Telfairia occidentalis* on body weight changes in alloxan-induced diabetic rats is shown in figure 2. Progressive decreases in body weight were observed in diabetic non treated rats when compared with the normal control rats and those in the other experimental groups. Interestingly, treatment with the methanol leaf extract of *Telfairia occidentalis* at 200 and 400 mg/kg BW significantly ($p < 0.05$) prevented the loss of body weight of the animals when compared with the diabetic non treated rats.

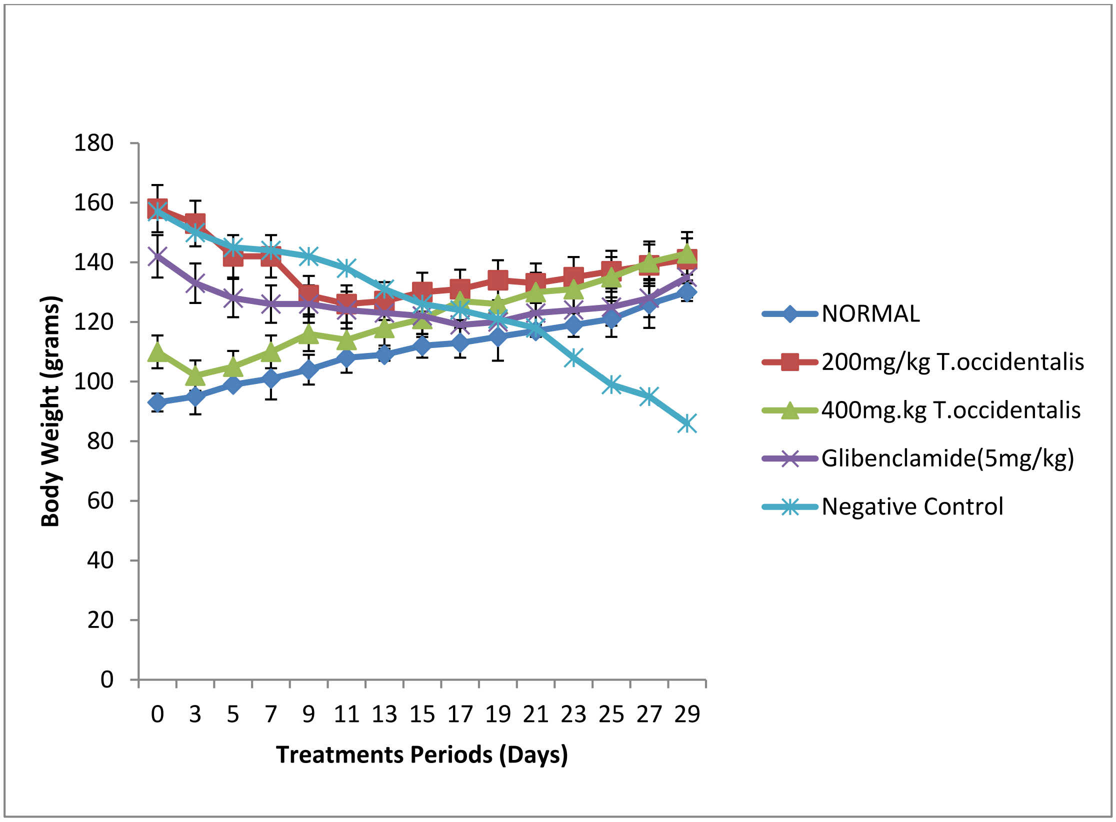

Figure 2: Effect of methanol leaf extract of *Telfairia occidentalis* on body weight changes of alloxan induced diabetic rat. Each bar point represents MEAN±SEM of triplicate determinations

4.0 Discussion

The quest for novel anti-diabetic medication from natural vegetation is very important since they contain bioactive phytochemicals that offer better activity and safety compared to conventional therapy [37]. Hence, evaluation of phytochemicals compositions of antidiabetic plants forms an important step towards the identification and development of medicinal plants for the treatment of diabetes [38,39]. Consequently, in the present study, the phytochemical screening of *Telfairia occidentalis* reveals the presence of phenol, alkaloids, tannins, glycosides and steroids and the absence of saponins and flavonoids. Quantitatively, the total phenols represent the most abundant secondary metabolite identified in methanol leaf extract of *Telfairia occidentalis* having a concentrations of 9570±13.24 µg/mg, tannins occur at the concentrations of 3000.56±23.45 µg/mg while alkaloid was found at the concentration of 0. .2378±0.013µg/mg in the crude methanol leaf extract of *Telfairia occidentalis*

Phenols and alkaloids are well known for their medicinal properties and have been implicated in the antidiabetics activities of various medicinal plants [40-42]. In addition, several phenolics and alkaloidal compounds have been isolated and reported for antidiabetic activity in in vitro and in vivo models [43,44]. Therefore, the levels of these phytochemicals in this plant extract is an indication that methanol leaf extract of *Telfairia occidentalis* could have some antidiabetic properties worthy of exploration.

Interestingly, the results of the present study confirmed that the methanol extract of *Telfairia occidentalis* exhibited a hypoglycemic effect in a dose-dependent manner. This is in line with studies by Oboh*,* [26] which indicate that the aqueous extract of *Telfairia occidentalis* had a significantly (P<0.05) higher total phenol than the ethanol extract which clearly indicate that the phenol content present in *Telfairia occidentalis* leave are more water-soluble than ethanol. Consequently, the aqueous extract could be a more potent antioxidant and antidiabetic than the ethanol extract. This gives credence to the fact that the aqueous extract of the leaf is commonly used in the management and prevention of anaemia and diabetes. Therefore, since the polarity of methanol is closer to that of aqueous, the methanol extract of *Telfairia occidentalis* has an effect closer to that of aqueous on the blood glucose level. However, this is in contrary to the work of Eseyin, *et al.[45]* who claimed that ethanol rather than aqueous extract the leaf exhibited higher activity.

The hypoglycaemic effect demonstrated by glibenclamide, a standard hypoglycaemic agent in the present study is not surprising, because glibenclamide has been reported to elicit its hypoglycemic effect via various mechanisms such as binding to ATP-K^+ channel, hence reduce glucose level, suppression of glucose production from the hepatic region, enhancing insulin sensitivity of the pancreas tissues and oxidation of fatty acid, enhancement of glucose uptake by peripheral tissues, decreasing of hepatic gluconeogenesis and glycogenolysis and reduction of glucose absorption from the gastrointestinal tract [46,47].

Studies have reported that diabetic induction leads to a great body weight loss as this is also part of the clinical symptom of diabetes according to AbouSeif and Youssef [48]. Thus, the gradual increase body weight gain observed in *T. occidentalis* treated groups as compared with normal (Figure 2) signifies the ameliorative effect of the plant extract on alloxan-induced weight loss. This ameliorative effect on body weight loss could be attributed to the effective glucose utilization and protein sparing induced by the treatment of the diabetic rats with the extract of *T. occidentalis*

Collectively, the present study demonstrated that *T. occidentalis* exhibited a hypoglycemic effect which could be attributed to its high phenolic components. The results of the present study are also in concordance with the work of Oboh*et al.,* 2004 who reported that the high phenol content of *T. occidentalis* is a major factor responsible for the therapeutic effect of in the *T. occidentalis* management/prevention of hemolytic anaemia, diabetes and other diseases as used in the traditional medicine.

5.0 Conclusions

From the results obtained, it is concluded that the methanol leaf extract of *T. occidentalis* has a significant hypoglycemic effect on alloxan-induced diabetic rats. The plant extract also ameliorated diabetes-induced body weight loss, hence serve as a source of novel potential antidiabetic agent.

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