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Hypoglycaemic activity of *Telfairia occidentalis* in rats

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Abstract

The hypoglycaemic activity of the ethanolic extract of leaf of *Telfairia occidentalis* was evaluated in normoglycaemic and alloxan–induced diabetic rats. This activity was compared with that of glibenclamide and that of a mixture of glibenclamide and extract. Blood glucose was measured by a glucometer. The extract produced significant reduction in blood glucose level at 2 hrs in normoglycaemic rats, and at 2 and 4hrs in diabetic rats after a single oral dose of 250mg/kg. The reduction in blood glucose level produced by the sub-acute administration of extract on the 5th, 10th and 15th day were comparable to that of glibenclamide. These results suggest that the leaves of *Telfairia occidentalis* possess hypoglycemic activity in normoglycemic and alloxan-induced diabetic rats and this could be beneficial in the ethnotherapy of diabetes mellitus.

Keywords: *Telfairia occidentalis;* Glibenclamide; Hypoglycaemic activity; Alloxan-induced diabetes.

Introduction

Herbal medicine practice has recently become the object of growing interest with the call by the World Health Organization (W.H.O.) for greater recognition of herbal practitioners. Before the advent of insulin therapy of diabetes in 1922, traditional plant remedies formed the cornerstone of antidiabetic therapies. The search for plants with antidiabetic activity is therefore currently receiving prominent attention, not only in Third World countries, but also in the western world due to the following reasons: non-availability of insulin (due largely to its high cost and because of both natural and man made disasters such as war); insulin resistance especially by type 2 diabetic patients; inability of oral antidiabetic drugs to re-instate a normal pattern of glycaemic control; and lack of access to orthodox medicine, custom, religion, folklore etc. especially in Third World countries (Hilary *et al.*,, 1998, Francis, 1998; Caroline, 1998).

Telfairia occidentalis, popularly known as fluted pumpkin, is a member of the cucurbitaceae family. The plant is cultivated extensively in the southern part of Nigeria (Bosa *et al.*, 1983). Both the leaves and seed of the plant are eaten because of their high content of proteins, vitamins and minerals (Johnson *et al.*, 1976). There are claims by traditional herbal practitioners that the leaves

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are medicinally valuable in the treatment of convulsion, anemia, atherosclerotic cardiovascular disease, hypertension, and impotence (Godwin, 2000; Iwu, 1983; Sofowora, 1986; Odoemena *et al.*, 1988; Elizabeth, 1988)

The antibacterial activity of the root (Odoemena and Essien, 1995) and erythropoietin value of leaf (Ajayi *et al.*, 2000) have been reported. The leaf extract is useful in the management of cholesterolemia, liver problems and impaired defence/immune systems (Eseyin *et al.*, 2005a, Eseyin *et al.*, 2005b). Preliminary work showed that the leaf extract possesses hypoglycaemic effect in normoglycaemic guinea pigs (Eseyin *et al.*, 2000). The present study was undertaken to investigate the antidiabetic activity of the leaf of the plant in rats.

Experimental

Plant material: The leaves of *T. occidentalis* were collected from the botanical garden of the Faculty of Pharmacy, University of Uyo. The plant was identified and voucher specimen was deposited at the Faculty of Pharmacy Herbarium University of Uyo.

Extraction: Fresh leaves (500g) were washed, chopped into smaller bits and ground with a mortar and pestle. The leaf material was extracted with 500ml of 96% ethanol in a soxhlet apparatus. The extract was concentrated *in vacuo* and dried in a desiccator.

Preparation of diabetic rats: Albino rats of both sexes, obtained from the University of Uyo animal house weighing 105.66±11.54g were made diabetic by intraperitoneal injection of alloxan monohydrate (150mg/kg). The animals were then allowed to rest for 7 days to allow the blood glucose level to stabilize. The rats had free access to standard laboratory rat chow and water and were kept under standard laboratory conditions.

Administration of extract:

(a) Normoglycemic rats: Twenty (20) normoglycaemic rats fasted overnight, were divided into four groups of 5 rats each and treated as follows:

Group I (control) – received 1ml of saline water orally only.

Group II - received orally 1ml of leaf extract (250mg/kg),

Group III - received orally 1ml of glibenclamide (5mg/kg),

Group IV – received orally a mixture of 0.5ml leaf extract (125mg/kg) and 0.5ml glibenclamide (2.5mg/kg).

(b) Diabetic rats: Twenty (20) overnight-fasted, alloxan-induced diabetic rats were divided into four groups (5 animals per group). Each group was treated as in (a) above.

(c) Sub-acute group: Twenty (20) diabetic rats were divided into four groups and treated as in (a) above. The various doses of extract and drugs were administered once daily for 15 days.

Estimation of blood glucose: Blood collected from the tail vein of the rats was analysed for glucose using the One Touch^R Glucometer. In both the normal and diabetic rats (i.e. a and b above), blood glucose was determined at time 0, 2 and 4 hours. While in the sub acute group (i.e. c above) blood glucose determination was carried out on the 5th, 10th and 15th day.

Statistical analysis: Data were expressed as mean ± S.E.M., n = 5. Student's t – test was used to check the level of significance. $P<0.05$ indicates significant reduction as compared with control group.

Results and Discussion

The results are presented in tables I and II and Figures 1-3. The percent change in glucose level is given in parenthesis and was calculated as follows:

$$\text{Percent change} = G_T/G_O \times 100\%$$

Where G_T = blood glucose concentration at time t; G_O = blood glucose concentration at time zero.

In normoglycaemic rats, the administration of extract of *T. occidentalis* produced significant reduction ($p<0.05$) in blood glucose concentration at 2hours while a mixture of the extract and glibenclamide produced significant reduction ($p<0.05$) but at 4 hours after administration of a single dose.

Table 1: Effect of ethanolic extract of *T. occidentalis* and mixture of *T occidentalis and* glibenclamide- on the blood glucose concentration (mg/dl) in normoglycemic and alloxan-diabetic Rats.

Treatment	0 h		2 h		4 h	
groups	Normoglycemic	Diabetic	Normoglycemic	Diabetic	Normoglycemic	Diabetic
Control (Saline water)	43.4±8.28 (100)	173±17.8 (100)	45.2±4.49 (105)	143.6±20.3 (83)	43.6±11.52 (101)	112.5±16.7 (63)
T. occidentalis (250mg/kg)	43.4±4.62 (100)	225±41.2 (100)	39.4±6.88 (91)**	104.6±38.3 (46)	40.4±7.33 (93)	53±0.1 (24)*
Glibenclamide (5mg/kg)	35±4.85 (100)	143±56.4 (100)	31.2±8.11 (89)*	94±22.5 (57)*	30.4±6.65 (87)*	54.4±16.3 (33)*
T. occidentalis (125mg/kg) + Glibenclamide (2.5mg/kg)	38.8±4.64 (100)	143±56.4 (100)	36.2±5.97 (93)	93.5±35.0 (65)	32.5±3.70 (84)*	54.5±20.2 (38)*

Mean ± SEM; * $p<0.05$; ** $p<0.1$; n = 5; values in parenthesis represent % change in blood glucose concentration

Table II: Effect of ethanolic extract of *T. occidentalis* on and a mixture of *T occidentalis* and glibenclamide on blood glucose level of diabetic rats (mg/dl) following sub-acute administration.

Treatment groups	Day 0	Day 5	Day 10	Day 15
Control	173±17.8 (100)	147.1±30.1 (85)	196±46.2 (113)	160.9±33.6 (100)
T. occidentalis (250mg/kg)	225±212 (100)	79±10.3 (35)*	123.8±17.9 (55)*	93.5±14.6 (42)*
Glibenclamide (5mg/kg)	164±14.1 (100)	81.5±12.1 (50)*	121.4±14.4 (73)*	114.9±16.7 (70)*
T. occidentalis (125mg/kg) + glibenclamide (2.5mg/kg)	143±54.1 (100)	210.5±59.8 (147)*	236.5±59.8 (165)*	193±33.1 (135)*

Mean ± SEM; *$p<0.05$; n=5; values in parenthesis represent % change in blood glucose concentration

Both the extract and a mixture of the extract and glibenclamide produced significant reduction ($p<0.05$) in blood glucose in the diabetic rats at 2hours in the normoglycaemic, and 2 and 4 hours in the diabetic rats.

In sub acute treatment (15 days), blood glucose level was significantly reduced ($p<0.05$) by both the extract and the mixture of extract and glibenclamide on day 5, 10, 15.

Glibenclamide (which is a sulphonylurea drug) lowers blood glucose level by stimulating beta cells of the pancreas to release insulin. Alloxan selectively destroys the pancreatic islet beta cells. The severe diabetes produced by alloxan results in blood sugar levels equivalent to a total pancreatectomy, hence sulphonylureas (such as glibenclamide) which act mainly through the beta cells, show only a small hypoglycaemic effect in this state. A plant extract producing a significant hypoglycaemia in a severely alloxan-diabetic animal must therefore be operating through a different mechanism (Huralikuppi *et al.,* 1991; Hikino *et al.,* 1989).

In the present work, glibenclamide showed hypoglycaemic activity in both normoglycaemic and alloxan-induced diabetic rats showing that the diabetes

induced by alloxan is mild and not severe, implying that the beta cells were not totally destroyed. This is confirmed by the blood glucose concentration of the alloxan-induced diabetic rats (143-225mg/dl). The hypoglycaemic activity of *T. occidentalis* was more pronounced in the alloxan-induced diabetic rats than in the normal rats. Furthermore, in the alloxan-diabetic rats the hypoglycaemic effect of the leaf extract was higher than that of glibenclamide.

The mixture of *T. occidentalis* and glibenclamide showed blood glucose reducing effect only at 4 hours in both the normal and alloxan-diabetic rats. The observed effect was not synergistic or additive.

The leaf of *T. occidentalis* showed tremendous hypoglycaemic effect which was far higher than that of glibenclamide on day 1,10 and 15 of the two weeks daily administration of the extract and drug. Surprisingly, the mixture of *T. occidentalis* and glibenclamide significantly increased the blood glucose levels in both the normal and alloxan-diabetic rat. The reason for this is not known. It is therefore obvious that the hypoglycaemic activity of the leaf of *T. occidentalis* at the dose of 250mg/kg was more effective than that of glibenclamide (5mg/kg) and mixture of *T. occidentalis* and glibenclamide. It can be deduced that the leaf of *T. occidentalis* did not act like the sulphonylureas, but through another mechanism which was different from that of glibenclamide. The extract could have lowered blood glucose concentration by decreasing the production and release of glucose from the liver (like the Biguanides) or through yet to be known mechanism.

Figure 1: Percent change in blood glucose level at diffrent times after administration of extract of Telfairia occidentals and glibenclamide to normoglycemic rats

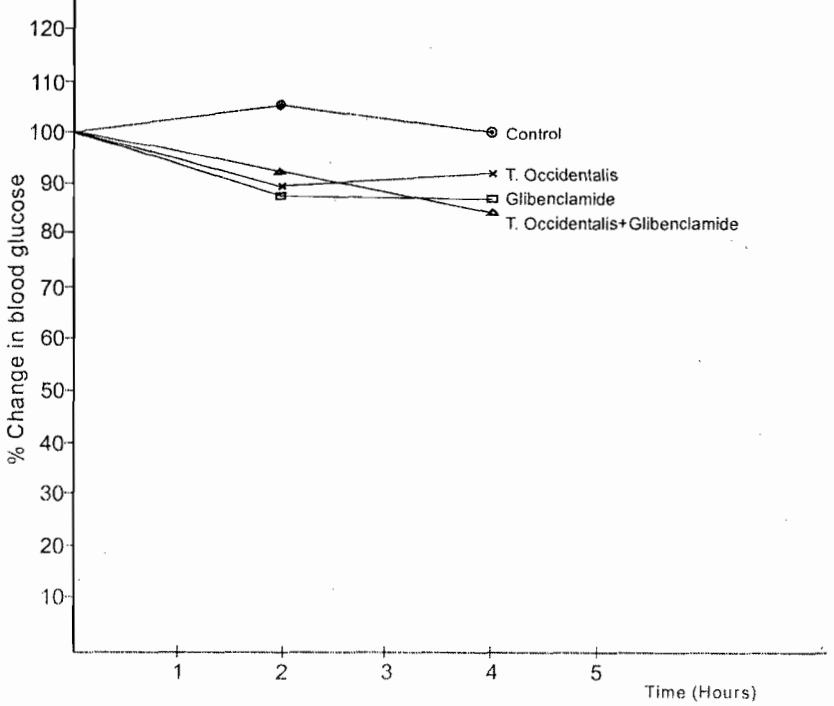
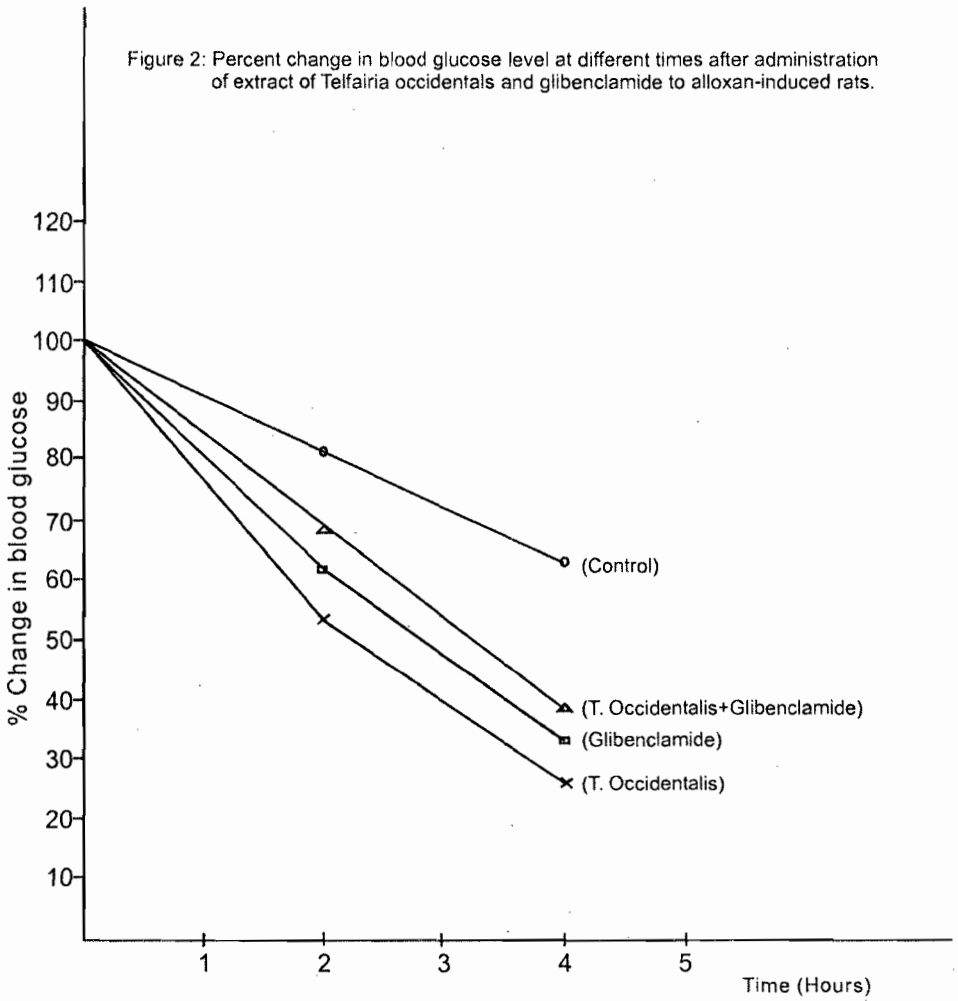


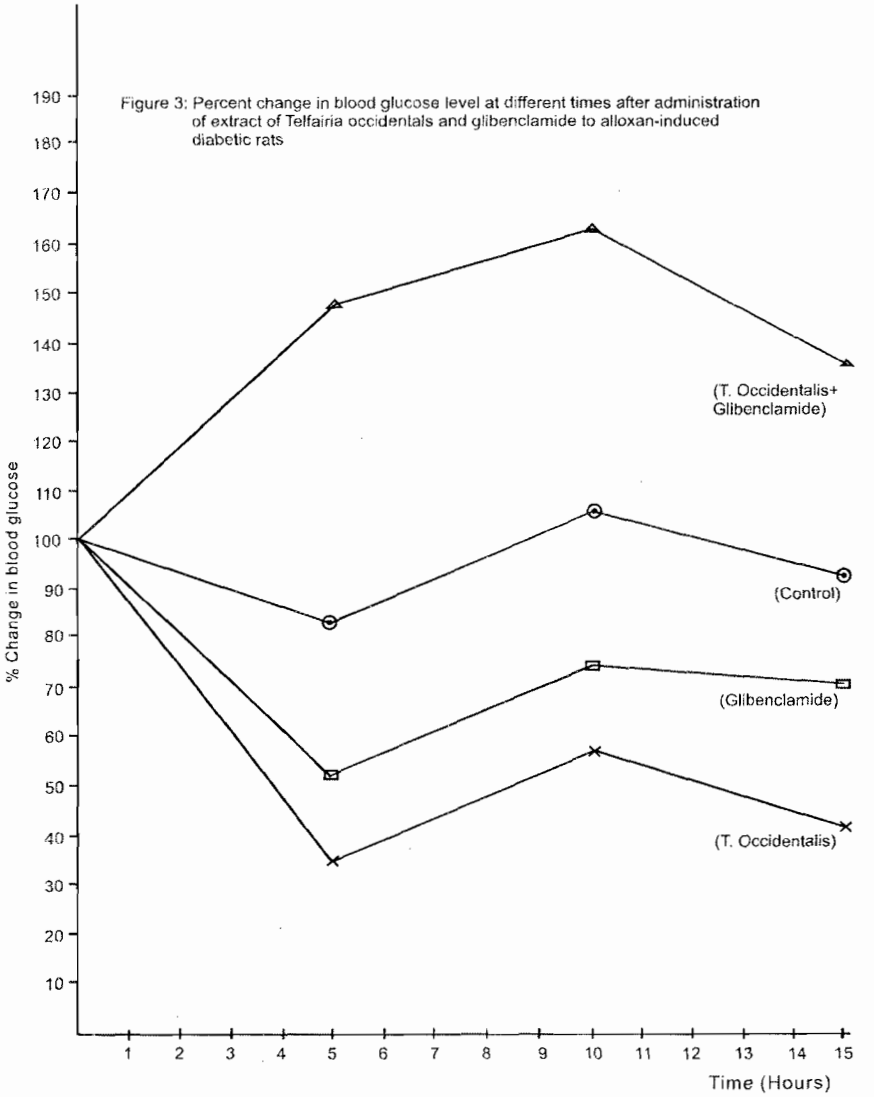
Figure 2: Percent change in blood glucose level at different times after administration of extract of Telfairia occidentals and glibenclamide to alloxan-induced rats.



The leaf of *T. occidentalis* is known to contain flavonoids, saponins and glycosides (Eseyin *et al.*, 2000). These phytochemical constituents (from other plants) have been reported to produce hypoglycaemic effect (Day, 1995). It is therefore possible that any of these constituents (and possibly others) of the extract could be responsible for the observed hypoglycaemic activity.

Further studies are currently in progress to isolate, identify the hypoglycemic constituents and also to determine the exact mechanism of the hypoglycaemic action of the extract of *T. occidentalis.*

In summary, the present study demonstrated that the hypoglycaemic activity of the leaf extract of *T. occidentalis* may form the bases for the use of this plant in ethnotherapy of diabetes mellitus



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