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The antihyperglycamic effect of *Telfaria occidentalis* in mice

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Summary

The hypoglycemic effect of *Telfaria occidentalis* was studied in mice. The effect of the aqueous extract of the leaves on blood glucose level were assessed in normoglycaemic, glucose induced hyperglycaemic and streptozotocin (STZ) induced diabetic mice. The aqueous extract given orally in 1 g/kg did not alter the blood glucose level in normoglycaemic mice. In glucose-induced hyperglycemia, antidiabetic activity was seen when the extract and glucose were administered simultaneously and when the extract was giving to the mice 60 minutes before glucose. In STZ-induced diabetic mice, a reduction in the blood glucose level was seen from day two of the administration of the extract. The hypoglycemic effect of the aqueous extract was compared with that of an oral dose of chlorpropamide (200 mg/kg) under the same conditions. The results of this study indicate that the aqueous extract of the leaves of *Telfaria occidentalis* possess hypoglycaemic activity.

Keywords: *Telfaria occidentals, glucose-induced hyperglycemia, STZ-induced diabetic mice, normoglycaemic mice.*

Résumé

L'effet d hypoglycemique que de Telfaria occidentalis avait ete etudie chez les souris. L'effet de liquide extrait liuide des feuilles sur le niveau de glucose dan avait ete mesure chez les normoglycemiques, hyglycemiques induient avec du glucose, et les souris diabetiques induient avec du streptozotocin (STZ). L' extnute liquide donne par voie orale a la dose de 1 g/kg n=avait pas affecte le taux de glucose chez les souris normoglycemiques. Chez les hyperglycemiques induient avec du glucose, l'activite antidiabetique etait observee auana l'extrait et le glucose etaient administres simultanenment et quand l=extrait etait adminstre aux souris 60 minutes avant le glucose. Chez les souris diabetiques induient avec du STZ. Une reduction du taux sanguin de glucose etait observee a partir du 2 ieme jour post adminstration de l'extrait. L'effet hypoglycemique de l'extrait de liquide a ete comparable a celui de la dose orale du chlorpropamide (200 mg/kg) dans les meme conditions. Les resultats de cette etudes montrent que le liquide extrait des feuilles de *Telfaria occidentalis* pocede une activite hypoglycemique.

Introduction

Telfaria occidentalis (fluted pumpkin) (Family: Cucurbitaceae) is a tropical plant grow primarily as a leafy vegetable in the southern part of Nigeria. It is called Ugu in Igbo language and Aworoko in Yorubalanguage. The leaves and the tender stems are consumed as pot herbs and the seeds from the female plants are eaten as nuts or milled and used as a soup thickener. The leaves are effective for sudden attacks of convulsions. The root extract is toxic and is considered very poison [1]. The toxic principle has not been identified, it was suggested to be a polyhydroxy cucurbitacin, a component of many cucurbitacea family to which *Telfaria occidentalis* belongs [2]. The leaves contains proteins, vitamins and flavours. The root and also the old stems contain sequiterpene and lactose in addition to cucurbitacine. The leave is claimed to be useful in the treatment of diabetes, which has led us to investigate its antihyperglycaemic properties.

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Materials and methods

Plant materials

The leaves of the plant was purchased in the Ilorin new market and sun dried. The leaves were authenticated by the Botany Department, Faculty of Science, University of Ilorin, Ilorin, Nigeria. The aqueous extract was extracted by soaking 20 g of the dried leaves in 1000 ml distilled water for 12 hours. This was filtered and the residue discarded. The resulting solution was evaporated to dryness in an oven at 400°C. The dry extract obtained was redissolved in 10 ml distilled water to make a final concentration of 200 mg/ml which was kept in the fridge for use.

Animals

Albino mice of both sexes weighing between 20 and 25 g used for the experiment were bred and supplied by the Pharmacology Department, University of Ilorin. The animals were exclusively fed with laboratory chow (Bendel feeds Ltd, Nigeria) and were allowed to drink tap water ad libitum. The experiments were carried out on normoglycaemic and hyperglycaemic mice. Before each experiment the animals were submitted to an 18 hour fasting period. Blood samples were collected from the tail of the mice.

Drugs

All chemicals were of analytical grade. Streptozotocin (STZ) (Sigma), glucose (May & Baker), chlorpropamide (Pfizer), Disodium edentate (Hopkins & Williams), ortho-toluidine (Hopkins & Williams), trichloroacetic acid (May & Baker) and glacial acetic acid (May & Baker).

Experimental procedures

Activity in normoglycaemic mice

The blood glucose concentration was determined at zero time. Then by means of oesophageal catheter, the aqueous extract (1 g/kg) was administered orally and glucose values were obtained 30, 60, 90, 120, 180 and 240 minutes later. The values obtained were compared with the corresponding control studies from mice receiving water only. Simultaneously, chlorpropamide was given orally to fasted mice at the same interval for the same duration [3,4].

Glucose-induced hyperglycemia

Initial glycaemia was determined in fasting mice. The first experiments was carried out by giving the aqueous extract (1 g/kg) and glucose simultaneously while the second experiment was carried out by giving the aqueous extract (1 g/kg) for 60 minutes before the glucose. A dose of 1 g/kg of glucose solution (50%) was administered orally. Blood glucose level was determined at

30, 60, 90, 120, 180 and 240 minutes. At the same time, a blank test was carried out using glucose only and determinations were performed at the same time intervals. Similarly chlorprophamide was given orally to fasted mice and the experiment was assessed under identical conditions of oral glucose load.

STZ-induced hyperglycemia

Diabetes was induced by giving intrapertoneally {100 mg/kg) 0.05M STZ dissolved in sodium citrate buffer (pH 4.5). The hyperglycaemic mice were allowed to rest for three days to stabilize the blood glucose level and then fasted for 18 hours. Blood glucose level at zero time was determined prior to aqueous extract and at 30, 60, 90, 120, 180 and 240 minutes after administration. The blood glucose determination continued per day and was allowed to act for 2 hours before determinations. Control studies were carried out using water only. Similarly, chlorpropamide was giving to diabetic mice at the same interval for the same duration. (Chlorpropamide was not given to the mice per day.

Determinations

Blood samples obtained through tail cut were added to tubes containing 0.05 ML disodium edetate solution (Na_2EDTA). The glucose level in blood was analysed using the ortho-toluidine method [5,6,7]. The blood glucose was expressed either in mg/100 ml of blood or as a percentage (%) change from initial glycaemia, using the following formula [4]

$$\%\text{glycaemia change} = \frac{Gx-Go}{Go} \times 100$$

(Go = glycaemia value at zero time after overnight fast; Gx = glycaemia value at x min after load). The mean value ± S.E.M. was determined and the significance of the difference between the means of the test and control groups was established by Student's t-test. Differences were considered to be significant for $P < 0.05$.

Results

Hypoglycaemic activity

The effect of the aqueous extract of *Telfaria occidentalis* on normoglycaemic mice is shown in Table 1 and Figure 1.

The effect of the aqueous extract on the blood glucose level in normoglycaemic mice did not differ significantly between the control and treated group. Chlorpropamide (200 mg/kg) produced significant hypoglycaemia from 60 mins upward.

Antidiabetic activity

Glucose-induced hyperglycaemia

The effect of the aqueous extract of Telfaria occidentalis on glucose induced hyperglycaemia is shown in Table 2 and figures 2a and 2b. Figure 2a shows the effect when the aqueous extract and glucose were administered simultaneously, whereas figure 2b shows the effect when the aqueous extract was administered 60 mins before the glucose. In both experiments, the aqueous extract markedly reduced the progressively elevated glucose value and the effect was statistically significant. The time taken for the reduction suggests that the absorption of glucose by the intestine may be a significant factor. Similarly, chlorpropamide also produced a significant hypoglycaemic effect. These reductions are statistically significant ($P < 0.05$).

Streptozotocin- induced hyperglycaemia

The effects of the aqueous extract of *Telfaria occidentalis* on STZ - induced diabetic mice are shown in Tables 3a and 3b and figures 3a and 3b. The extract did not produced a reduction in blood glucose level of STZ - induced diabetic mice within four hours (Table 3a and fig. 3a), but a reduction of the blood glucose level was observed from day 2 upward (Table 3b and fig. 3b) and it was statistically significant ($P < 0.05$). Also chlorpropamide did not produce a statistically significant change in STZ - induced diabetic mice.

Table 1: Effect produced by aqueous extract of *Telfaria occidentalis* (1 g/kg) and chlorpropamide (200 mg/kg) on blood glucose level in normoglycaemic mice.

Treated	n	0 min	30 min	60 mim	90 min	120 min	180 min	240 min
Water	8	50.60±3.50	50.93±2.30	53.12±2.30	53.12±3.46	54.68±2.61	53.18±2.24	47.81±1.45
Normoglycaemic	6	52.16±5.36	45.50±2.74	35.00±3.17	27.50±2.89	22.50±3.30	24.16±4.18	22.91±4.26
Chlorpropamide								
Normoglycaemic +	6	58.33±2.90	62.91±3.31	59.58±2.28	60.00±3.36	58.33±1.54	53.33±2.39	55.00±1.55
Telfaria occide.								

occide. = occidentalis

Mean blood glucose concentration (mg/100 ml).

*Mean ± S.E.M. Astericks refer to significant means *.P<0.05.*

Those without astericks were not significantly different from the control group.

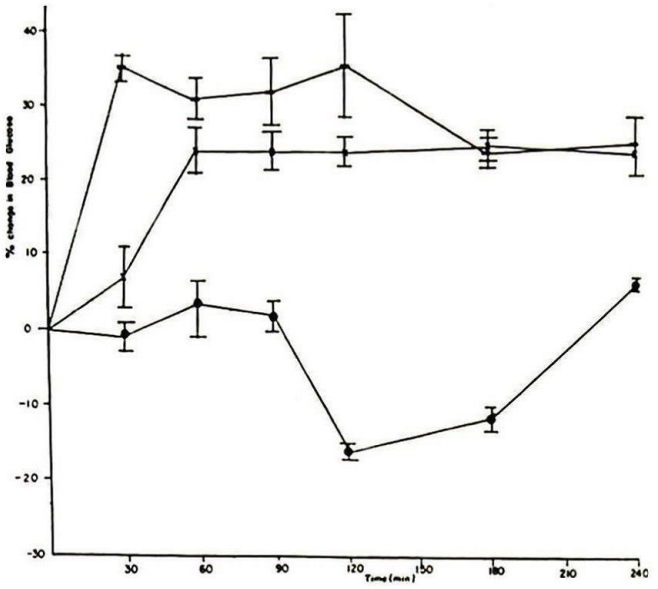

Fig.1: Effect of aqueons extract of *Telfaria occidentalis* (1g/kg) and chlorpropamide on normoglycaemic mice.
X——X, WA = Water, .●——●. CHL = Chlorpropamide, ■——■, TO = Telfaria occidentalis, N = 6

Table 2: Effect produced by aqueous extract of Telfari a occidentalis (1 g/kg) and chlorpropamide (200 mg/kg) on blood glucose level in glucose induced hyperglycaemic mice.

Treated	n	Omin	30 min	60 min	90 min	120 min	180 min	240 min
Control (glucose)	6	53.33±8.04	144.16±9.47	104.16±6.23	192.50±5.49	76.25±2.65	46.25±3.02	40.41±2.85
Chlorpropamide & glucose (s) simultaneously	6	52.5±8.04	130.00±6.11	95.41±6.90	67.91±3.96 *	49.58±3.74 *	43.75±2.73	45.83±3.08
Chlorpropamide (60 min) glucose	6	52.75±3.33	129.66±3.04	90.83±5.81	70.00±3.36 *	58.75±2.40 *	48.33±2.11	49.58±1.36
Telfaria occidentalis Glucose(s)	6	59.16±2.30	75.41±1.36 *	69.16±2.39 *	65.83±3.01 *	57.91±2.37 *	55.83±0.52	57.08±0.76
Telfaria occidentalis (60 min) + glucos	6	58.33±5.59	102.08±2.18 *	62.5±1.73 *	59.58±1.36 *	60.41±3.06 *	57.5±0.86	59.16±1.49

Mean blood glucose concentration (mg/100ml)
*Mean ± S.E.M. Astericks refer to significant mean *P < 0.05. Those without astericks were not significantly different from the control group.*

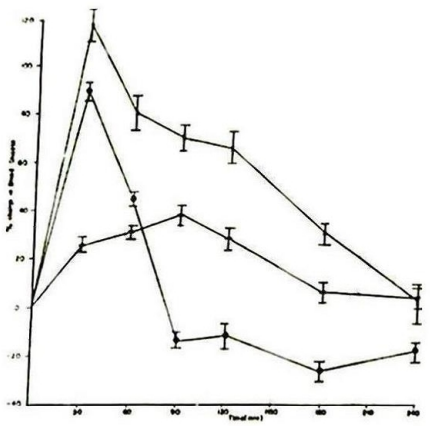

Fig. 2a: Effect of aqueous extract of telfaria occidentials (1g/kg) and chlorpropamide on glucose B induced hyperglycaemic mice.
X——X GU = Glucose, ●——●. CHL + GU = Chlorpropamide + Glucose
■——■ TO + GU(s) Telfaria occidentalis + Glucose. S = simultaneously N = 6

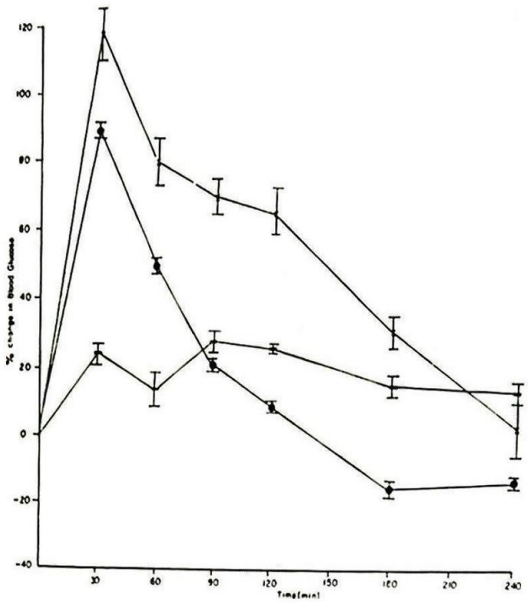

Fig.2b Effect of aqueous of Telfaria occidentals (1g/kg) and chlorpromide on glucose B induced hyperglycaemic mice.
X——X GU = glucose, ●——●. CHL (60 m) + GU = chlorpropamide + glucose.
■——■ TO (60m) + GU = Telfaria occidentalis + glucose 60 m = 60 minutes N = 6

Table 3: Effect produced by aqueous extract of *Telfaria occidentalis* (1 g/kg) and chlorpropamide (200 mg/kg) on blood level in STZ - induced diabetic mice.

Treated	n	O min	30 min	60 min	90 min	120 min	180 min	240 min
STZ mice + water	6	137.50±2.50	135.83±3.52	130.41±3.06	130.33±3.21	132.83±3.85	133.00±1.12	34.00±1.77
STZ mice + chlopropamide	6	138.66±2.80	146.25±1.68	142.08±2.54	139.16±4.33	13375±2.31	136.00±3.43	134.16±2 01
STZ + mice *Telfaria occide*	6	146.66±5.20	148.50±14.20	140.41±2.85	141.66±2.48	143.75±3.63	147.08±3.75	148.60±3.51

Mean blood glucose concentration (mg/100 ml)
Mean ± S.E.M.

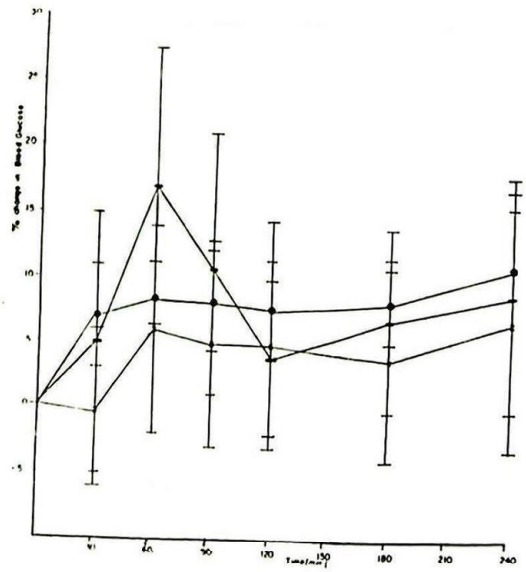

Fig. 3a Effect of aqueous extract of *Telfaria occidentalis* (1 g/kg) and chlorpropamide on STZ B induced hyperglycaemic mice
X——X WA = Water ●——●. CHL = Chlorpropamide
■——■ TO = *Telfaria occidentalis* N= 6

Table 3b - Effect produced by aqueous extract of *Telfaria occidentalis* (1g/kg) on blood glucose level in STZ - induced Induced diabetic mice (extract giving per day)

Treated	n	day 1	day 2	day 3	day 4	day 5	day 6	day 7
STZ mice + *Telfaria occidentalis*	6	146.66±5.20	112.91±8.50 *	103.33±7.46 *	102.91±4.77 *	100.41±5.03 *	87.91±3.74 *	88.75±3.22 *

Mean blood glucose concentration (mg/100 ml)
*Mean ± S.E.M. Astericks refer to significant means *P < 0.05*
Those without astericks were not significantly different from the control group.

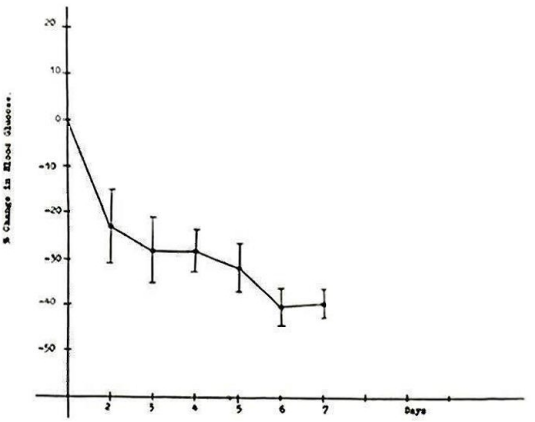

Fig. 3b- Effect of aqueous extract of *telfaria occidentals* (1 g/kg) on STZ B induced hyperglycaemic mice.
■——■ TO = *Telfaria occidentalis* N = 6

Discussion and conclusions

The results of the present study show that aqueous extract of *Telfaria occidentalis* did not alter the blood glucose level in normoglycaemic mice. In STZ- induced diabetic mice, there was a reduction which was statistically significant from day two upwards. The aqueous extract reduced the progressive increase of blood glucose level jn glucose-induced hyperglycaemia. The antihyperglycaemic effect was pronounced right from 30 mins to about 120 mins, suggesting that the extract may be able to reduce the intestinal absorption of glucose [8,9].

For comparison, the effect of chlorpropamide was also investigated on the blood glucose level under the same conditions. Chlorpropamide produced a significant hypoglycaemic effect in normoglycaemic mice and in glucoses-induced hyperglycaemia, in keeping with the known mechanism of action. STZ causes permanent destruction of the pancreatic beta cells [10] and chlorpropamide produces hypoglycaemia principally by stimulating pancreatic beta cells to release more insulin [11] hence it has no effect on the blood glucose level of STZ-induced hyperglycaemia.

In conclusion, the results of the present study show that *Telfaria occidentalis* leaves possess active constituents capable of lowering blood glucose level and hence provide some scientific evidence for the folk use of this drug.

Further pharmacological and chemical investigation are needed in order to identify the exact mechanism of the antihyperglycaemic effect and to isolate the active principle involved.

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