International Journal of Pharmacy and Pharmacology ISSN: 2326-7267 Vol. 4 (10), pp. 001-005, October, 2015.
Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effect of *Telfairia occidentalis* on oral glucose tolerance in rats

Olorunfemi Eseyin[1]*, Patrick Ebong[2], Eyong Eyong[2], Oladoja Awofisayo[1] and Akeem Agboke[3]

[1]Department of Pharmaceutical and Medicinal Chemistry, Faculty of Pharmacy, University of Uyo, Nigeria.
[2]Department of Biochemistry, University of Calabar, Nigeria.
[3]Department of Pharmaceutics and Pharmaceutical Technology, University of Uyo, Nigeria.

Accepted 10 June, 2015

The effect of ethanolic extracts of the leaf, seed and fruit of *Telfairia occidentalis* on oral glucose tolerance was determined. 500 mg/kg of the leaf, seed and fruit extracts were administered separately to a set of overnight fasted rats simultaneously with glucose solution (1 g/kg). Also, 500 mg/kg of the extracts were separately administered 45 min before glucose solution (1 g/kg) was given. Blood glucose concentration was evaluated at 0, 15, 30, 45 and 60 min after treatment in both cases. In the simultaneous administration of extracts with glucose, only the leaf extract reduced glucose concentration significantly with AUC and GI values of 11,121.75 and 80.7% compared to control values of 13,782.00 and 100%. When the extracts were administered 45 min before glucose, the leaf and fruit extracts reduced glucose levels significantly with AUC and GI values of 11,240.25 and 84.5%; 10,650.75 and 80.1%, respectively, compared to control values of 13,294.50 and 100%. These results suggest that the ethanolic leaf extract of *T. occidentalis* could be useful in treatment of impaired oral glucose tolerance.

Key words: *Telfairia occidentalis,* oral glucose tolerance, glucose, area under the curve, glycemic index.

INTRODUCTION

Diabetes mellitus is an epidemic occurring in adults throughout the world and is the leading cause of kidney failure, heart attack, blindness and lower limb amputation. It is the fourth main cause of death in most developed countries. The prevalence of diabetes is estimated to reach 330 million by the year 2025, according to International Diabetes Federation, with the greatest potential increase being in Africa and Asia. This numerical increase will occur in developing countries. Thus by the year 2025 over 75% of people with diabetes will reside in developing countries, as compared to 62% in 1995 (Hillary et al., 1998).

In Nigeria, it is the most common endocrine disease. In the past, it was believed that insulin was the “messiah” drug that would wipe away diabetes. Unfortunately, it has been established that neither insulin (hormonal) injection nor any other antidiabetic drug in the market reinstate normal pattern of glycemic control (Francois, 1998; Marshal et al., 1998). Moreover, the World health organization (WHO) estimates that 80% of people in developing countries depend on traditional medicine for their health needs, and 85% of traditional medicine involves the use of plant extracts. In other words, about 4 billion people in the world rely on plants as source of drugs. This has led researchers to continue their search for the “miracle drug” for treatment of diabetes from plants.

Telfairia occidentalis is a perennial plant which has been given United States Department of Agriculture Germplasm Resources Information Network (GRIN) Nomen number of 80125. The fruits are among the largest known (Bosa and Mgbeogwu, 1963). The popularity of the plant stems from the high nutritional value of its leaf and seed which are eaten as food (Sanni, 1982; Johnson and Johnson, 1976; Akoroda, 1990). The leaves are much sought after by sheep and goats and are used as fodder and cover crop for livestock. The seed oil is suitable for the manufacture of soap, vegetable oils, paints and varnishe (Oyenuga, 1964; Nworgu et al., 2007; Irvine, 1969; Burkhill, 1985; Odoemena and

*Corresponding author. E-mail: femieseyin2@yahoo.co.uk. Tel: +2348023291687

Onyeneke, 1988).

It has been reported that the plant can be used to treat anemia, convulsion, atherosclerotic cardiovascular disease, high blood pressure, hypercholesterolemia, arthritis, liver problems and inflammatory conditions (Oyolu, 1978; Ajayi et al., 2000; Alada, 2000; Oboh, 2005; Iwu, 1983; Oluwole et al., 2003). The hypoglycaemic activity of the plant (leaf and seed) has also been documented (Eseyin et al., 2000; Aderbigbe et al., 1999; Nwozo et al., 2004; Eseyin et al., 2005; Eseyin et al., 2007).

But information on the mechanism of action of the hypoglycaemic activity of the plant is scanty. This work was undertaken to determine the effect of different parts of the plant on oral glucose tolerance in rats. Here we report the effectiveness of the leaf extract of *T. occidentalis* in correcting impaired glucose tolerance.

MATERIALS AND METHODS

Plant collection and identification

The leaves and fruit of *T. occidentalis* were collected from the medicinal plant farm of the Faculty of Pharmacy, University of Uyo, Nigeria. The plant was identified by Dr Kola Ajibesin of the Pharmacognosy Department, Faculty of Pharmacy, University of Uyo, Nigeria, and voucher specimen was deposited in the same department.

Plant extraction

Leaves

Fresh leaves (2 kg) were chopped into smaller bits and ground with a mortar and pestle. The leaf material was transferred into a clean 10 L jerry can containing four litres of ethanol (96%) for 72 h at room temperature with periodic shaking. The mixture was filtered to obtain the leaf extract.

Fruit

The fruits were sliced open and the pulp and seeds evacuated. The outer coating (pericarp) was then chopped into small bits. Four litres of ethanol (96%) was poured into a clean 10 litres jerry can containing 2.5 kg of the fruit material and left for 72 h at room temperature with periodic shaking. The mixture was filtered to obtain the fruit extract.

Seed

The seeds evacuated from the fruits above were used. The outer coating (mesocarp) of the seed was removed. The seeds were chopped into smaller bits and 2 kg macerated in four litres of ethanol (96%) in a 10 L jerry can for 72 h at room temperature with periodic shaking. The mixture was filtered to obtain the seed extract.

Concentration and drying of the extracts

The extracts obtained above were concentrated using a rotary evaporator. The concentrated extracts were dried in a desiccator containing Silica gel (self indicating).

Animals

White albino rats (Wister strain) of both sexes purchased from the University of Uyo animal house were used. The rats had free access to standard chow and water. They were kept under standard laboratory conditions at room temperature in wooden cages. They were exposed to 12 h light and 12 h dark periods. All animal experiments conformed to NIH guidelines as outlined in NIH publiccation number 80 - 23 (revised 1978).

All the animals used were fasted overnight before administration of extract and/or glucose. After the administration of the extract and/or glucose till the end of the experiment they were not given access to water and food.

Effects on blood glucose levels when extracts were administered simultaneously with glucose

Four groups of rats (n = 5) were treated as follows:

Group A received 1 g/kg glucose solution and 500 mg/kg ethanolic leaf extract orally (simultaneously). Group B received 1 g/kg glucose solution and 500 mg/kg ethanolic seed extract orally (simultaneously) . Group C received 1 g/kg glucose solution and 500 mg/kg ethanolic fruit extract orally (simultaneously). While group D (control) received 1 g/kg glucose solution only. Group E (positive control) received only distilled water. Blood collected from the tail vein of the rats was analyzed for glucose using the One Touch Glucometer (Lifescan, U.S.A.) at 0, 15, 30, 45 and 60 min after treatment with glucose and extract.

Effects on blood glucose levels when extracts were administered 45 min before glucose loading

Four groups of rats (n=5) were treated as follows:

Group A received 1 g/kg glucose solution 45 min after 500 mg/kg ethanolic leaf extract was administered orally.
Group B received 1 g/kg glucose solution 45 minutes after 500 mg/kg ethanolic seed extract was administered orally.
Group C received 1 g/kg glucose solution 45 min after 500 mg/kg ethanolic fruit extract was administered orally.
Group D (control) received 1 g/kg glucose solution alone 45 min after distilled water was administered. Group E (positive control) received only distilled water.

Blood collected from the tail vein of the rats was analyzed for glucose using the One Touch Glucometer (Lifescan, U.S.A.) at 0, 15, 30, 45 and 60 min after administration of glucose treatment.

Statistical analysis

Results obtained were expressed as Mean ± Standard error of the mean. Analysis of variance and Scheffe's post test were used to compare the means. Values of $p < 0.05$ were regarded as being significant.

AUC (Area under the curve) was calculated from the formula:

$$AUC=1/2(t_1-t_0)\ (C_0+C_1) + ½(t_2-t_1)\ (C_1+C_2) \ldots$$

T = time, C = Concentration of glucose
GI (Glycemic index) was calculated from the formula:

Table 1. Effect of ethanolic fruit, seed and leaf extracts of *T. occidentalis* (500 mg/kg) on blood glucose levels when administered 45 minutes before glucose loading (1 g/kg).

Treatment	Blood glucose concentration in mmol/L				
	0 min	15 min	30 min	45 min	60 min
Positive control	2.57 ± 0.16 (100 ± 8.6)	2.37±0.20 (92.2 ± 7.8)	2.66 ± 0.43 (103.5± 16.7)	2.78 ± 0.38 (108.2 ± 14.8)	2.50 ± 0.33 (97.3 ± 12.8)
Control	2.74 ± 0.18(100 ± 6.6)	8.04 ± 2.0(218.3 ± 73.0)	7.98 ± 2.41(213.8± 88.0)	10.72 ± 2.01(282.2 ± 73.4)	8.86 ± 2.22(244.0 ± 81.0)
Fruit	2.21 ± 0.23(100 ± 10.4)	3.80 ± 1.98(171.6 ± 89.6)*	4.47 ± 1.91(202.2± 86.4)	4.06 ± 0.89(183.5 ± 40.3)*	4.54 ± 1.11(205.5 ± 50.2)
Leaf	2.62 ± 0.26(100 ± 9.9)	5.21 ±1.00(198.7 ± 38.2)	4.93 ± 1.13(188.1 ± 43.1)*	5.42 ± 1.66(206.8 ± 63.4)*	5.54 ± 1.50(211.5 ± 57.3)*
Seed	2.01 ± 0.18(100 ± 9.0)	4.06 ±1.12(202.2 ± 55.7)	4.43 ± 1.48(220.3 ± 73.6)	6.05 ± 1.98(300.8 ± 98.5)*	5.16 ± 2.23(256.7 ± 110.9)

Mean ± SEM, n = 5. * Significantly different from control, $p < 0.05$. Figures in parenthesis are percent of 0 h value.

Table 2. Effect of ethanolic fruit, seed and leaf extracts of *T.occidentalis* (500 mg/kg) on blood glucose levels when administered simultaneously with glucose (1g/kg).

	Blood glucose concentration in mmol/L				
Treatment	0 min	15 min	30 min	45 min	60 min
Positive control	2.41 ± 0.19(100 ± 7.8)	2.55 ± 0.21(105.8 ± 8.7)	2.67 ± 0.27(110.8 ± 11.2)	2.49 ± 0.20(103.3 ± 8.3)	2.51 ± 0.18(104.1 ± 7.5)
Control	2.18 ± 0.12(100 ± 5.5)	5.00 ± 2.0(229.4 ± 91.7)	5.64 ± 2.01(258.7 ± 92.2)	4.86 ± 1.32(222.9 ± 60.6)	6.88 ± 2.12(315.6 ± 97.2)
Fruit	2.32 ± 0.24(100 ± 10.3)	6.03 ± 2.77(260.0 ± 119.4)	6.44 ± 1.98(277.6 ± 85.3)	5.02 ± 2.33(216.5 ± 100.4)	4.90 ± 1.31(210.8 ± 56.5)*
Leaf	2.27 ± 0.96(100 ± 42.6)	4.83 ± 1.92(212.6 ± 84.6)	4.44 ± 1.86(195.6 ± 82.0)	4.17 ± 1.76(183.5 ± 77.5)*	4.53 ± 1.49(199.5 ± 65.6)*
Seed	2.48 ± 0.28(100 ± 11.3)	5.97 ± 2.22(240.8 ± 89.5)	5.55 ± 1.88(223.9 ± 73.8)	5.11 ± 1.69(206.0 ± 68.1)	5.05 ± 1.33(203.7 ± 53.6)*

Mean ± SEM, n=5. * Significantly different from control, $p < 0.05$. Figures in parenthesis are percent of 0 hour value.

GI = AUC (Test material)/AUC (Control)

RESULTS

The results are shown in Tables 1 and 2.

Seed

The ethanolic seed extract increased blood glucose level significantly at 60 min only when administered simultaneously with glucose. When administered 45 min before glucose loading, the seed extract increased glucose level significantly (300.8%) at 45 min after glucose loading.

Fruit

Simultaneous administration of fruit extract and glucose produced a reduction in blood glucose level at 60 min only. However, when the fruit extract was administered 45 min before glucose loading, blood glucose level was significantly reduced 15 and 45 min after glucose loading.

Leaf

When simultaneously administered with glucose, the leaf extract reduced blood glucose concentration significantly at 15, 30, 45 and 60 min.

Administration of the leaf extract 45 min before glucose loading also significantly reduced blood glucose level at 30, 45 and 60 min after glucose loading.

DISCUSSION

Oral glucose tolerance testing (OGTT) is a standard procedure that is used to diagnose diabetes. Each year 1 - 5% of people with impaired glucose tolerance (IGT) actually develop diabetes. Since impaired oral glucose tolerance (IGT) is indicative of a predisposition of an animal to diabetes, agents that exhibit antihyperglycaemic effect

capable of bringing blood glucose concentration within normal limits will help to arrest the progression of impaired glucose tolerance to diabetes. Glycemic index (GI) is also a useful tool in measuring the rate at which food or substances provide glucose to the blood and this stimulates insulin release. Substances with low GI are therefore helpful for diabetic patients.

Seed

The seed extract exhibited significantly antihyperglycaemic effect only at 60 min when it was simultaneously administered with glucose. It gave an area under the curve (AUC) of 12,338.25 compared with control value of 13,782.00 and glycemic index (GI) of 89.5%. When the same extract was administered before glucose loading it reduced glucose level significantly at 45 min only and gave an AUC of 13,524.75 compared with control value of 13,294.5 and glycemic index of 101.7%. These results showed a lack of antihyperglycaemic effect of the extract over a period of time. The extract also did not reduce the AUC significantly. This is an indication that the seed extract had no effect on oral glucose tolerance.

Fruit

The fruit extract showed antihyperglycaemic activity only at 60 min after the simultaneous administration of the extract and glucose. It gave an AUC of 13,642.5 which was almost the same with that of the control (13,782.00) and a GI value of 89.5%. However, administration of the extract before glucose loading reduced blood glucose level significantly. It gave AUC of 10,650.75 and GI of 80.1%. This shows that the fruit extract was effective in improving oral glucose tolerance when administered 45 min before glucose loading. It was able to reduce AUC below the control value.

Leaf

Both the simultaneous administration of the leaf extract with glucose and 45 minutes before glucose loading produced significant antihyperglycaemic effect over a period of time (45, 60 and 30, 45, 60 min, respectively). In the two cases, the AUC were almost the same (that is, 11,121.75 when administered simultaneously and 11,240.25 when administered 45minutes before glucose loading, respectively). The gycemic values were almost the same in the two cases (80.7 and 84.5%). These results indicate that the leaf extract is capable of correcting impaired glucose tolerance in rat, thereby significantly reducing the possibility of such animals developing full blown diabetes.

This result is consistent with findings of some researchers that some plants have the ability to correct or improve OGT. For example, cocoa powder extract was found to lower blood glucose level in hyperglycemic rats (Amin et al., 2004). *Moringa oleifera* Lam was found to have an ameliorating effect for glucose intolerance in rats (Ndong et al., 2007). Dryopteris spp (Aspidiaceae) have also been known to improve glucose utilization in rats (Khookhor et al., 2007). Taiwo et al. (2009) also reported that *Vernonia amygdalina* significantly reduced glucose tolerance.

In conclusion, the results of this work show that the leaf extract of *T. occidentalis* exhibited the capacity to correct impaired glucose tolerance (IGT). The fruit extract also showed some ability to correct IGT but in a limited way, while the seed did not possess this ability to improve IGT.

REFERENCES

Aderbigbe AO, Lawal BA, Oluwagbemi JO (1999). The anti-hyperglycemic effect of Telfairia occidentalis in mice. Afr. J. Med. Med. Sci., 28: 171-175.

Ajayi AI, Ajayi TC, Omokaro EU, Halim NKD (2000). Erythropoietic value of pumpkin leaf extract in rabbits-a preliminary study. Nig. J. Physiol. Sci., 16: 1-3.

Akoroda MO (1990). Ethnobotany of Telfairia occidentalis (Cucurbitaceae) among Igbos of Nigeria. Econ. Bot., 44: 29-39.

Alada ARA (2000). The haematological effect of Telfaira occidentalis diet Preparation. Afr. J. Biomed. Res., 3: 185-186.

Amin I, Faizul HA, Azil R (2004). Effect of cocoa powder extract on plasma glucose levels in hyperglycemic rats. Nutrition. Food. Sci., 34(3): 116-121.

Bosa EO, Mgbeogwu CM (1963) Fluted Pumpkin, *Telfairia occidentalis.* West African Vegetable Crop. Econ. Bot., 37: 145-149.

Burkhill HM (1985). The Useful Plants of West Tropical Africa. White Friars Press London. p. 12.

Eseyin OA, Ebong P, Ekpo A, Igboasoiyi A, Oforah E (2007). Hypoglycaemic effect of the seed extract of *Telfairia occidentalis* in rats. Pak. J. Biol. Sci. 10: 498-501.

Eseyin OA, Igboasoiyi AC, Oforah E, Nkop N, Agboke A (2005).Hypoglycaemic activity of *Telfairia occidentalis* in rats. J. Pharm. Bioresources, 2: 36-42.

Eseyin OA, Oforah E, Dooka BD (2000). Preliminary study of the hypoglycemic action of the extract of leaf of *Telfairia occidentalis* in Normoglycemic Guinea Pigs. Global J. Pure Appl. Sci., 6: 639-641.

Francois B (1998). Diabetes in Africa. The diabetes Annual/Diabetes. Ed. Marshal SM, Home, P. D., Rizza RA. Elsevier BV. Sci., Pp. 430-440.

Hillary KR, William HH (1998). Global Burden of diabetes 1995-2005: Prevalence, Numerical estimates and Projections. Diabetes Care, 21(9): 1414-1431.

Irvine FR (1969). West Africa Crops. 3ed. Oxford University Press. London.

Iwu MM (1983). Traditional Igbo Medicine. Report of a sponsored project by the institute of African studies, UNN, Nsukka Nigeria.

Johnson EJ, Johnson TJ (1976). Economic Plants in a Rural Nigerian Market. Econ. Bot., 30: 375-381.

Khookhor O, Bolin Q, Yoshihara O, Sato Y (2007). Effect of Mongolian plants on in vivo insulin action in diabetic rats. Diabetes. Res. Clin. Pract., 75(2): 135-140

Ndong M, Uehera M, Katsumata S, Suzuki K (2007). Effects of oral administration of Moringa oleifera Lam of glucose tolerance in Goto-Kakizaki and Wistar rats. J. Clin. Biochem. Nutr., 40(3): 229-233.

Nworgu FC, Ogungbenro SA, Solasi KS (2007). Performance and some blood chemistry indices of broiler chicken served fluted pumpkin leaves extract supplement. Am. Eurasia. J. Agric. Environ. Sci., 2: 90-98.

Nwozo SO, Adaramoye OA, Ajaiyeoba EO (2004). Antidiabetic and hypolipidemic studies of *Telfairia occidentalis* on alloxan induced diabetic rats. Niger. J. Nat. Prod. Med., 8: 45-47

Oboh G (2005).Hepatoprotective property of ethanolic and aqueous extracts of fluted pumpkin (*T. occidentalis*) leaves against garlic-induced stress. J. Med. Food. 8: 3-560.

Odoemena CS, Onyeneke EC (1988). Lipids of Fluted Pumpkin Seeds. First African Conference on Biochemistry of Lipid, pp. 147-151.

Oluwole FS, Falode AO, Ogundipe OO (2003). Anti-inflammatory effect of some common Nigerian vegetables. Niger. J. Physiol. Sci., 18: 35-38.

Oyenuga VA (1964). Nigeria's Foods and Feeding Stuffs: Their Chemistry and Nutritive value Ibadan. University Press. Nigeria.

Oyolu C (1978). Relatively unknown vegetable: fluted pumpkin (*Telfairia occidentalis*). Procceding first Ann. Conf. Hortic. Soc. Nigeria. NIHORT. Ibadan, Nigeria.

Sanni SB (1982). The fluoride contents of common Nigerian vegetable. J. Sci. Fd. Agric., 33: 686-687.

Taiwo IA, Odeigah PGC, Ogunkanmi LA (2009). The gycemic effects of V. amygdalina and *V. tenoreana* with tolbutamide in rats and the implications for the treatment of diabetes mellitus. J. Sci. Res. Dev., 11: 122-130.