HYPOGLYCAEMIC EFFECTS OF *HYPOXIS HEMEROCALLIDEA* (FISCH. AND C. A. MEY.) CORM 'AFRICAN POTATO' METHANOLIC EXTRACT IN RATS

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SUMMARY: This study was designed to examine the hypoglycaemic effects of methanolic extract of Hypoxis hemerocallidea (family: Hypoxidaceae) corm (commonly known as 'African Potato') in normal (normoglycaemic) and in streptozotocin-induced diabetic (hyperglycaemic) rats. Adult, male Wistar rats (Rattus norvegicus) weighing 250-300 g were used. 1, 2, 4, 8 and 24 hours after oral administration of graded doses of African Potato methanolic extract (APME, 100-800 mg/kg p.o.) into the rats, blood samples were taken from the tail veins of the rats, and blood glucose concentrations were determined by using Bayer's Glucometer Elite® and blood glucose strips. Glibenclamide (5 mg/kg p.o.) was used as reference antidiabetic drug for comparison. Following acute treatment, relatively moderate to high doses of APME (100-800 mg/kg p.o.) produced dose-dependent, significant ($p<0.05$-0.001) reductions in the blood glucose concentrations of both normal and diabetic rats. The plant extract-induced maximal reductions in the blood glucose concentrations of normal and diabetic rats were found to be 35.07% and 55.32% respectively. Glibenclamide (5 mg/kg p.o.) also produced significant ($p<0.01$-0.001) reductions in the blood glucose concentrations of normal and diabetic rats. Glibenclamide-induced maximal reductions in the blood glucose concentrations of normal and diabetic rats were found to be 46.27% and 68.71% respectively. Although 'African Potato' is less potent than glibenclamide as an antidiabetic agent, the results of this experimental study indicate that the herb possesses hypoglycaemic activity, and thus, lend credence to the suggested folkloric use of 'African Potato' in the management of adult-onset diabetes mellitus in some communities of South Africa.

Key Words: Hypoxis hemerocallidea, 'African Potato' methanolic extract (APME), diabetes mellitus.

INTRODUCTION

Although the use of herbal remedies for the treatment of diabetes mellitus has greatly declined in Europe and other Western nations since the introduction of insulin and oral hypoglycaemic agents (9, 10), approximately 80% of the people in the rural African communities still rely on the use of plant remedies to treat and/or manage diabetes mellitus. To date, only a few of the African medicinal plants used in folklore medicine as herbal remedies for the treatment of diabetes mellitus have received scientific scrutiny,

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despite the fact that the World Health Organization has recommended that medical and scientific examinations of such plants should be undertaken (13). South Africa is blessed with a rich flora, some of which are used for magical and medicinal purposes. The focus of this study is on one of such miracle medicinal plants, namely, *Hypoxis hemerocallidea* (Fisch. and C.A. Mey.) (family: Hypoxidaceae). *Hypoxis hemerocallidea* is a tuberous perennial plant with broad, slightly hairy leaves which are arranged one above the other and spreading outwards, and bright yellow star-shaped flowers borne on long, slender stalks. The tuberous root stock of the plant, known as the 'corm', is widely used in South African folk medicine as a remedy for an array of human ailments. Because of its physical resemblance to the Irish potato, the 'corm' of the plant has been christianed 'African Potato' by the African natives of South Africa. The traditional healers of South Africa have employed the corms of *H. hemerocallidea* as a 'muti' (i.e., medicine) for centuries. Today, the humble 'African Potato' has been claimed to be an amazing medicine in the fight against various modern human diseases. This South African 'wonder plant medicine' has been reported to be an effective remedy against HIV/AIDS, arthritis, yuppie flu, hypertension, adult-onset diabetes mellitus, psoriasis, gastric, and duodenal ulcers, cancer, tuberculosis and urinary tract infections, asthma, and some central nervous system disorders (1,2,5,7,11,12). The core aim of this study was to examine the hypoglycaemic property of *H. hemerocallidea* corm methanolic extract (APME) in normal and diabetic rats with a view to providing a pharmacological basis for the use of 'African Potato' in adult-onset, Type-II diabetes mellitus in some parts of South Africa.

MATERIALS AND METHODS

Plant material

Fresh corms of *H. hemerocallidea*, locally known as 'African Potato', were purchased from a fruit market along West Street in Durban, South Africa, between October, 1999 and March, 2000. The corms were identified by the Taxonomist/Curator of the University of Durban-Westville's Department of Botany as those of *Hypoxis hemerocallidea* [Fisch. and C.A. Mey. (family: Hypoxidaceae)].

Preparation of methanolic extract

One kilogramme (1000 g) of the fresh corms were washed, cut into small pieces, and homogenized in a Waring blender. The homogenate was Soxhlet extracted twice, on each occasion with 2.5 litres of 99.5% uniAr methanol at room temperature, for 24 hours with shaking. The combined extracts were filtered and concentrated to dryness under reduced pressure at 30 ± 1°C. The resulting extract was freeze-dried, finally giving 74.55 g (7.46% yield) of dark-brown, powdery, crude African Potato methanolic extract (APME). Aliquot portions of the plant extract residue were weighed and dissolved in distilled water for use on each day of our experiment.

Animal material

Adult, male Wistar rats (*Rattus norvegicus*) weighing 250-300 g were used. The animals were randomly divided into three (A, B and C) groups of 20 rats per test and control groups.

Experimentals

In the diabetic Group A rats diabetes was induced by intraperitoneal injections of streptozotocin (STZ, 100 mg/kg). Diabetes was allowed to develop in these STZ-treated rats over a period of five to ten days. In the control group C normal (normoglycaemic) rats were treated with intraperitoneal injections of distilled water (0.5 ml) only. In group B normal rats did not receive any treatment. All the animals were kept and maintained under laboratory conditions of temperature, humidity, and light, and allowed free access to food (standard pellet diet) and water. STZ-treated rats with blood glucose concentrations $\geq$18 mmol/L were considered to be diabetic, and used in this study. Glibenclamide (5 mg/kg p.o.) was used as the standard antidiabetic (hypoglycaemic) agent for comparison. The test compounds [i.e., African Potato methanolic extract (APME, 100-800 mg/kg p.o.) and glibenclamide (5 mg/kg, p.o.)] were administered to the rats by gastric intubation; 1, 2, 4, 8 and 24 hours before blood samples were taken from the animals. Blood samples were collected from the 'tail vein' of each rat for blood glucose analysis. Blood glucose concentrations were determined by means of Bayer's Glucometer Elite® and Blood Glucose Test Strips.

Data analysis

Blood glucose concentration data obtained from the blood samples of the plant extract (APME) and glibenclamide-treated rats, as well as those obtained from distilled water-treated control rats were pooled, and expressed as means ($\pm$ S.E.M.). The difference between the plant extract-or glibenclamide-treated test, and distilled water-treated control means was analysed statistically by using *Student's t-test*. Values of $p \leq 0.05$ were taken to imply statistical significance.

Table 1 : Effects of *Hypoxis hemerocallidea* corm 'African Potato' methanolic extract (APME, 800 mg/kg p.o.) and glibenclamide (5 mg/kg p.o.) on blood glucose concentrations (mmol/L) of normal (normoglycaemic) rats. Figures given represent means (± SEM) of values obtained from 15-20 rats.

Rat Groups	Before Treatment	After Treatment					Maximal Reduction	% of Maximal Reduction
	0 h	1 h	2 h	4 h	8 h	24 h		
Control (0,5 ml distilled water)	5.78±0.90	5.76±0.93	5.78±0.89	5.77±0.91	5.76±0.92	5.78±0.89	0.02	0.35
APME (800 mg/kg p.o.)	5.76±0.93	5.51±0.91	5.03±0.90	4.43±0.89*	3.74±0.75***	5.75±0.91	2.02	35.07***
Glibenclamide (5 mg/kg p.o.)	5.77±0.91	5.11±0.90	4.11±0.85*	3.66±0.81**	3.10±0.51***	5.71±0.90	2.67	46.27***

*p<0.05, **p<0.01, ***p<0.001

RESULTS

Relatively moderate to high doses of African Potato methanolic extract (APME, 100-800 mg/kg p.o.) produced dose-dependent, significant (p<0.05-0.01) reductions in the blood glucose concentrations of normal (normoglycaemic) and diabetic (hyperglycaemic) rats; 1, 2, 4, 8 and 24 hours after acute treatment (compared with distilled water-treated control rats). Glibenclamide (5 mg/kg p.o.) also produced significant (p<0.01-0.001) reductions in the blood glucose concentrations of normal (normoglycaemic) and diabetic (hyperglycaemic) rats; 1, 2, 4, 8 and 24 hours following acute treatment (compared with distilled water-treated control animals). Acute treatment of normal, control rats with distilled water (0.5 ml p.o.) alone produced insignificant (p>0.05) reductions in their blood glucose concentrations. Tables 1 and 2 summarize the hypoglycaemic effects of the plant extract (compared with glibenclamide and distilled water) in normal (normoglycaemic) and STZ-treated, diabetic (hyperglycaemic) rats.

DISCUSSION AND CONCLUSION

The results of this experimental study indicate that methanolic extract of African Potato (APME) possesses hypoglycaemic activity in the normal (normoglycaemic) and diabetic (hyperglycaemic) mammalian animal models used. Although the plant extract is less potent than glibenclamide, from the experimental evidence obtained in this study, it is not unlikely that the plant extract, like glibenclamide, induces hypoglycaemia by stimulating insulin release and action, thereby enhancing

Table 2 : Effects of *Hypoxis hemerocallidea* corm 'African Potato' methanolic extract (APME, 800 mg/kg p.o.) and glibenclamide (5 mg/kg p.o.) on blood glucose concentrations (mmol/L) of STZ-treated, diabetic (hyperglycaemic) rats. Figures given represent means (± SEM) of values obtained from 15-20 rats.

Rat Groups	Before Treatment	After Treatment					Maximal Reduction	% of Maximal Reduction
	0 h	1 h	2 h	4 h	8 h	24 h		
Control (0,5 ml distilled water)	19.10±3.08	19.05±3.12	19.01±3.10	18.97±3.06	18.87±3.01	19.00±3.11	0.23	1.20
APME (800 mg/kg p.o.)	19.00±3.12	15.97±3.05	12.92±3.00*	10.75±2.35**	8.49±2.02***	14.15±2.95*	10.51	55.32***
Glibenclamide (5 mg/kg p.o.)	19.05±3.10	16.28±3.02	10.85±2.41*	8.64±2.21**	5.96±1.48***	12.36±2.76*	13.09	68.71***

*p<0.05, **p<0.01, ***p<0.001

cellular uptake and utilization of glucose in the animals. Although African Potato has been reported to contain large amounts of phytosterols and sterolins, it has been widely claimed that the major chemical constituent of the herb is the inactive diglucoside prodrug named 'hypoxoside', which is readily deconjugated by β-glucosidase to form the lipophilic, biologically-active aglycone called 'rooperol' (1-6,11). At the moment, it is not known for certain which of the plant's metabolite/s is/are responsible for the hypoglycaemic effect of the herb. Since the mechanism of the hypoglycaemic effect of the plant extract still remains speculative, further studies are required to unravel the mechanism of hypoglycaemic action of the herb, and to shed more light on the hypoglycaemic constituent/s of the plant. In conclusion, the results of this experimental study indicate that African Potato possesses hypoglycaemic activity, and thus, lend credence to the suggested folkloric use of the herb in the management of adult-onset diabetic mellitus in certain parts of South Africa.

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