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Original Article

SWEET POTATO (*IPOMEA BATATAS*) TUBER - POTENTIAL ORAL ANTI-DIABETIC AGENT

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Diabetes is one of the ailments that traditional healers had claimed cure capabilities by the use of some medicinal plants. Sweet potato (*Ipomea batatas*) is one of such plants in which much claims had been made. However, this claim has not previously been scientifically validated and experimentally assessed.

In this investigation, alcoholic extract of sweet potato was investigated for its oral anti-diabetic activity. This attempt was supported by a phytochemical study of the extract which revealed the presence of glucosides, glucosinolates, and alkaloids. Results obtained from the investigation showed alcoholic extract of sweet potato to exhibit potent oral anti-diabetic property. The activity was comparatively higher than that of diabenese - standard drug in use presently in clinics for treating diabetes. The mechanism of action and the active principle of that extract was discussed.

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Running title: Antidiabetic potency of sweet potato

INTRODUCTION

In most parts of the world, sweet potato is being heavily cultivated. In some of these areas, local populace is putting parts of the plant to good medicinal use. In Nyasaland, the leaves of sweet potato is used as lactagogue, while in Ghana, the leaves of sweet potato when grounded with salt is used for the successful treatment of witlow. In the Philippines however, the plant has been claimed to be useful as an anti-diabetic without formal experimental authentication. (Jones and Cresordoff 1971).

However, phytochemical tests have shown that the main constituents of sweet potato are sugar, glucose, organic acids, steroids, volatile oils and vitamins. In 1971, Jones and Geserdoff reported the isolation of Ipomacin, which can be converted by the proteolytic enzymes to a polypeptide. The present investigation is undertaken to scientifically prove and support the claims of traditional healers that sweet potato tuber has potent anti-diabetic activity. It is also the objective of the investigators to identify the active principles with a view to develop the herb into cheap efficacious anti-diabetic agent which could be alternatively used by the low income communities instead of the more expensive orthodox or standard anti-diabetic drugs that are currently available. There appears to be a dearth of relevant information in the literature about the anti-diabetic activity of sweet potato.

MATERIALS AND METHODS

Collection and authentication of plant material: The white sweet potato *(Ipomea batatas)* was obtained from Bodija market near the University of Ibadan on the 10th of January 1997. It was authenticated at the herbarium of the Botany Department of the University of Ibadan, Nigeria as the tubers of sweet potato and was confirmed as *Ipomea batatas* under the family - convovulaceae. A voucher specimen was deposited in the same department.

Preparation of the root material: The root tuber was washed clean with water and rinsed with distilled water, the epiderm

was peeled off, and the root tuber sliced and chopped into very small pieces.

300gm of the sliced potato (S.P.) root tuber was soaked with 350mls 60% aqueous ethanol in a glass container, and kept in a cupboard for a period of one week. Thereafter, the soaked root was filtered and concentrated under vacuum using a rotary evaporator at a very low temperature of 40°C - 50°C, the extract was allowed to dry over calcium chloride crystals for 24 hours to yield a light brown paste. The total weight of the crude extract was 0.53gm. A water extract of sweet potato (AESP) was also obtained by soaking 300gm of sliced potato root tuber in about 300mls of water. Phytochemical screening of the extracts was carried out as follows:

Phytochemical Investigations

The ethanol extract of sweet potato EESP and AESP whiter extract were subjected to standard phytochemical tests and screened for the presence of protein. Alkaloids and other metabolites were also screened using standard procedures. The presence or absence of the following secondary metabolites was also tested:

Glucosinolate: Evolution of hydrocyanic acid (HCN) which is detectable by colouring of sodium picrate paper (after wetting with sodium carbonate) was used to confirm the presence of glucosinolate (Ahmed 1972); further confirmation was done by the presence of yellow spots obtained from iodine vapour (Gimelin and Kyaer, 1970).

Myrosinase: This was confirmed by the staining of the mesocarp slice in the presence of Million's reagent (Chung-Tang, 1973).

Experimental Investigation of anti-diabetic activity

Albino rats of both sexes used in the study were fed with commercial chow for seven days prior to the experiment. They were divided into five groups (I - V). In a preliminary investigation, test-dose experiment using 2mg, 3mg, 5mg, 8mg, and 10mg/kg body weight of the extract was carried out in rats. This investigation revealed that an optimum dose of 5mg/kg per body weight was adequate for the body study. Thus, 5mg/kg body weight of EESP and AESP was considered for the main experiment. The investigation proceeded as follows:

Group III rats were fed orally with the extracts at a dose of 5mg/kg-body weight, 72 hours after alloxan monohydrate was injected (i.m.). Group IV rats also received the standard anti-diabetic drug diabenese at a dose of 5mg/kg-body weight representing the control for diabetics treated with the control drug, 72 hours after the administration of alloxan monohydrate. Group V rats served as the control to show the effect of the extracts on normoglycaemics: thus they were given the extract orally with no induction of diabetes.

Group II rats received alloxan-monohydrate alone without any treatment with neither the extract nor diabenese. This also served as control for the untreated diabetic animals.

Consequently, blood samples for glucose analysis were taken from all the sets of rats 24 hours at 6 hours intervals. The glucose content of each of the blood samples was determined by glucose oxidase method using o-dianisidine as modified by Trinder (1969).

Statistical Analysis

All results were expressed as mean ± SEM of the number of investigations in each group. Differences within the same group were compared using the paired t-test while differences between two groups were compared using the (unpaired) student t-test (Sneedor, 1967).

RESULTS

Phytochemical screening:

Phytochemical screening of EESP shows the presence of Glucosinolate, Isiothio-cyanate and myosinolate as the major secondary metabolites.

Antidiabetic study:

The results of this study are displayed in Tables 1 (for EESP) and 2 (for AESP). Group I rats were untreated normoglycaemics which served as control. Group V rats are also normoglycaemics but treated with extract of sweet potato. In these groups of rats, there were no significant changes in the blood glucose levels throughout the period of investigation (Table 1).

This shows that the extract under study had no adverse effect on normoglycaemics.

Group III rats were diabetic rats treated with extract of sweet potato. At each point of time during the study there was gradual reduction of blood glucose level. This reduction was very significant (P<0.005). In Group IV rats, similar reduction was also observed. These rats were treated with Diabenese.

Fig.1 shows the percentage reduction in blood glucose levels after feeding 5mg/kg ESSP, AESP and diabenese to rats. The result shows that the ethanolic extract exhibited an anti-hyperglycaemic effect comparable to the standard reference drug, diabenese.

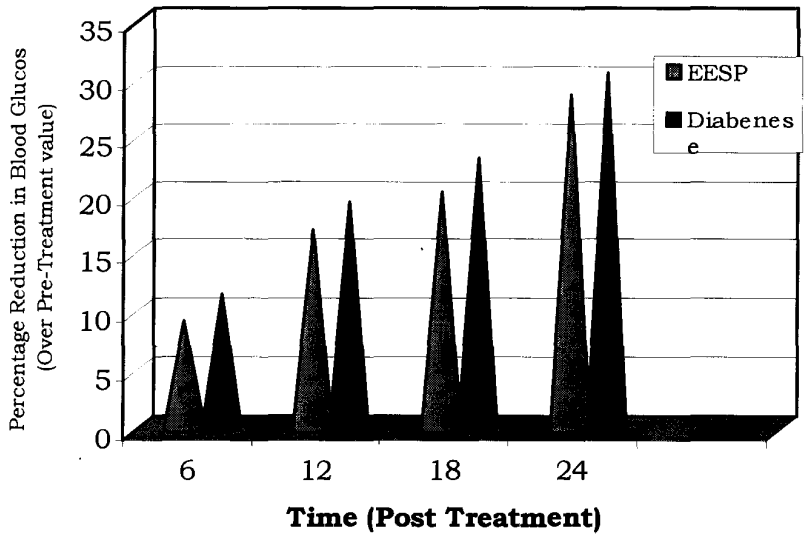
TABLE 1.
COMPARATIVE REDUCTION VALUES IN BLOOD GLUCOSE LEVEL IN mg/100 ml. OF ETHAOLIC EXTRACT OF SWEET POTATO TUBERS (*Ipomoea* batatas) & DIABENESE

Group	Dose of EESP	Initial BDGL (mg/kg)	Pre-treatment in mg/kg	POST TREATMENT Average Blood Glucose Reduction in mg/100ml after feeding animals as orally with extract of Sweet potato tuber to alloxan – induced diabetic rats (AIDR)			
				6 HRS	12 HRS	18 HRS	24 HRS
I	5mg/kg	82.05 ± 0.02		82.07 N.S ± 5.0	82.05N.S ± 4.0	82.06N.S ± 2.0	82.05N.S ± 3.0
II	5mg/kg	83.50 ± 2.0	131.50 ± 4.0	131.45N.S ± 4.0	131.50N.S ± 3.0	131.52N.S ± 2.0	131.50N.S ± 2.0
III	5mg/kg	84.50 ± 4.0	129.50 ± 2.0	117.70** ± 3.0	107.70** ± 4.0	103.39** ± 3.0	92.70** ±2.0
IV	5mg/kg	83.50 ± 3.50	133.00 ± 3.0	117.85 ± 2.0	107.46 ± 4.0	102.25 ± 2.0	92.46 ±3.0
V	5mg	83.05 ± 4.0	83.05 ± 4.0	83.05N.S ± 4.0	83.10N.S ± 4.5	83.20N.S ± 3.0	83.20N.S ± 2.0

BDGL - BLOOD GLUCOSE LEVEL. AIDR - ALLOXAN - INDUCED DIABETIC RATS
N.S Not significant (C.F. pre-treatment value, paired t- test) **p < 0.005 (C.F. pre-treatment value, paired t-test

TABLE 2:
BLOOD GLUCOSE IN MG/100ML IN RATS FED WITH OR WITHOUT AQUEOUS EXTRACT OF SWEET POTATO TUBER (AESP)

Group	Dose of AESP	Initial BGDL	BGDL 72 HRS	AVERAGE BGDL IN MG/100ML + S.D. AFTER FEEDING EXTRACT OF SWEET POTATO TO AIDR			
				6 HRS	12 HRS	18 HRS	24 HRS
I	5mg/kg	82.00± 2.00		82.01± 2.00	82.00± 2.00	82.02 ± 2.00	82.02 ± 2.00
II	5mg/kg	83.50 ± 2.00	132.50 ± 2.00	132.49 ± 2.00	132.51 ± 0.02	132.50 ± 2.00	132.52 ± 2.00
III	5mg/kg	84.50± 2.00	131.25 ± 2.00	126.73 ± 2 00	124.55 ± 2.00	121.85 ± 2.0	120.25 ± 2.00
IV	5mg/kg	83.00± 0.02	131.50± 0.02	109.05 ± 3.00	115.05 ± 3.00	104.66 ± 3.00	101.00 ± 2.00
V	5mg/kg	82.50± 0.02	82.51± 0.02	82.50 ± 0.02	82.52 ± 0.02	82.50 ± 0.02	82.51± 0.02



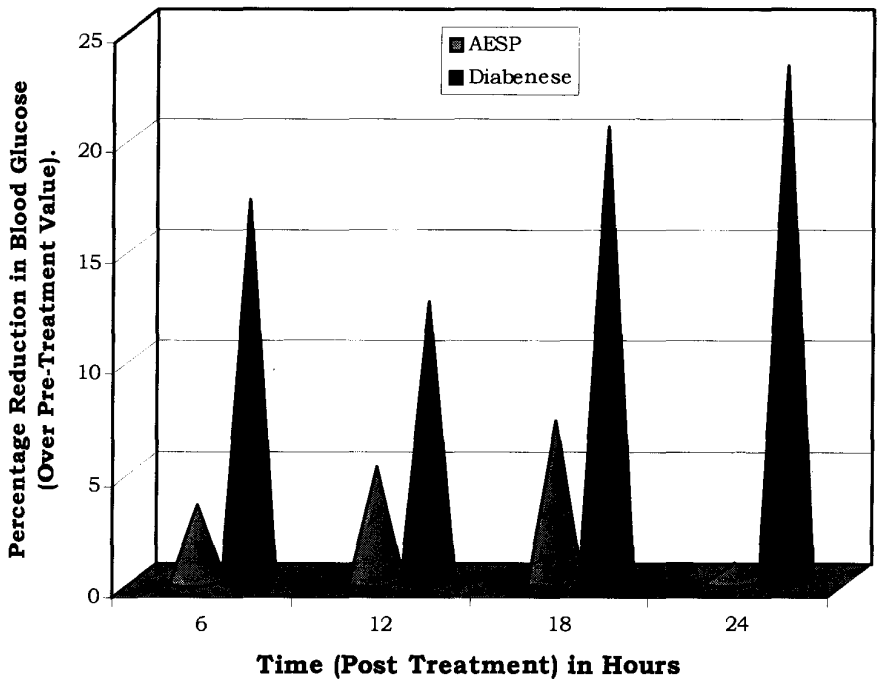


Fig. 1(a and b):
Percentage reduction in blood glucose in diabetic rats treated with ethanolic (EESP, 1a) and aqueous (AESP, 1b) extracts of sweet potato. The values are compared with the reduction by the reference drug, Diabenese

DISCUSSION

The extract of sweet potato tuber has been reported to serve different uses in folklore medicine. Walt and Breyer Brandjwik (1962) reported that extract of the tuber was used as an anti-diabetic agent in the Philippines. Our findings further confirmed this assertion. In this investigation ethanol extract of sweet potato (*Ipomea batatas*) produced a consistent and smooth effect of lowering the blood glucose level in the experimental animal. The ethanol extract showed noticeable activity after the six hours of administration, rising gradually to its peak of activity after 18 hours. This hypoglycemic effect however reduced considerably at the twenty-fourth hour. Comparatively, aqueous extract produced noticeable activity at the sixth hour, rising gradually to the peak of activity at the eighteenth hour, only to produce a weak or low activity at the twenty-fourth hour. This may be attributed to the presence of certain principles of the aqueous extract.

Phytochemical analysis of EESP in the present study shows that it contains among other things, myrosinase, Glucosinolate and isothiocyanates. This observation lent support to previous reports of Wagner *et. al.,* (1965), Gimelin *et. al.,* (1970), Chung. Tay (1973) and Ettlinges (1968). The isothiocyanates, which might be present in sweet potato, might have caused inhibitory action in the body system of the diabetic animals, thus inhibiting the breakdown of special type of glucose molecules and hence the level of blood glucose in the blood will be reduced. This is a hypothesis, to which further studies may be directed. Also, this mechanism of action would be valid only when isothiocyanates, which has been shown to be present in these extracts of sweet potato, are shown to be responsible for the anti-diabetic activity. Work is continuing in our laboratory on these outstanding aspects of the investigation.

In conclusion, this study shows that the extract of sweet potato could exhibit considerable oral anti-diabetic activity as claimed by traditional medicine healers. Also, the oral anti-diabetic activity of this extract was comparatively higher than that of Diabenese - a drug of choice, orally to treat diabetics in clinics.

REFERENCES

Chung-Shin Tang (1973): Localisation of Benzylglucosinolate and Thioglucosidase in *C. papaya* Fruits. Phytochem. 12, 769-781.

Crossby, D.G. and L.J. Anderson (1984): The organic constituents of food II J. **Food Science** 29, 287-293.

Ettlinger, M.G. and Kjaar, A. (1968): Sulphur compounds in plants. Recent Advances in phytochemistry. 1, 59-144.

Gmelin R. and Kjaar A. (1970): Glucosinolates in plants. Phytochemistry. 7, 239, 1325.

Jones, D.B. and C.E.F. Cresordoff 1971, Ipomacin a globulin from sweet potatoes protein derived from Ipomocin by enzymatic action. J, Biol. Chem. 93, 110.

Linchanstein, E.P., Morgon, D. Muellier, C.H. (1964): Property of Isothiocynates. J. Agric. Food Chem. 12. 158.

Matsuo, M. (1970): Detection of Sulphur compounds in plants. J. Chromatography 49, 323.

Skeleton G.S. and Grudacho (1968): Constituents of *C.papaya.* J. Chromatography 35. 283.

Snedecor G.W., Cochram C. (1967): Statistical methods. 6th Ed. New Dehli.

Trinder, P. (1969): Determination of blood glucose. J. Clin. Pathology, p. 246.

Wagner H., Horhammer, L. and Nuffer, H. (1965): Detection of isothiocyanates in plant material, Arzneinmittel-forsch. 15, 453.

Walt, J.M. Breyer Brandjwik, M.C. (1962): In Medicinal and Poisonous Plants of Southern and Eastern Africa. p.167. E.S. Livingstone Limited, London.