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RESEARCH ARTICLE

THE POTENTIAL OF CUCURBITA SPECIES (PUMPKIN) AS DIETARY ADJUNCT IN THE
MANAGEMENT OF DIABETES: THEIR QUALIFYING MEDICINAL AND
PHARMACOLOGICAL PROPERTIES

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ABSTRACT

Diabetes Mellitus is characterized by increased frequency of urination (polyuria) and increased appetite (polyphagia) due to loss of glucose. As a result of a parallel exponential increase in the incidence of diabetes and fatality due to diabetes vis-à-vis the disappearance of the pumpkin-eating culture of the native Igbo populations of Eastern Nigeria since the late 1960s, this study investigated the effect of admixed ground pumpkin flesh on the texture, particle size and carbohydrate content of a protein food, *Voandzeia subterranean* seed flour paste meal, as a possible adjunct diet in diabetes management; The paste formed from a mixture of *Voandzeia subterranean* seed flour; palm oil; cold, warm or hot water and sodium chloride were deep-fried in scoops, alone or were mixed with cooked or ground raw pumpkin and deep-fried to produce a composite meal. Blended-in sliced onions or sliced leafy vegetables of *Ocimum gratissimum*, *Ocimum basilicum*, *lufa cylindrica* or ground *Zingiber officinale* were included as additional enrichments of the meal but were not essential factors in the study. A comparison of the fried cakes of the *Voandzeia subterranean* seed flour paste alone with the fried cakes of the *Voandzeia subterranean* seed flour mixed with ground flesh of pumpkin showed that the flesh of cooked or ground raw pumpkin softened the texture of the *Voandzeia subterranean* seed flour cake; eliminated particulation of the fried *Voandzeia subterranean* seed flour paste cake; made the consistency of the cake homogenous; reduced the carbohydrate nature of the cake; increased the protein content of the cake and reduced its shelf life. The efficacy of pumpkin (Cucurbitaceae) species in the remission of diabetes is exemplified by *Momordica charantia* (which is itself a *Cucurbita specie*), fruit, juice or powder which several studies reported that they produced decreases in blood glucose levels and/or improvements in the glucose-tolerance tests of diabetic patients who received various doses of them. And, since the flesh of *Cucurbita species* have been found to contain 0.5-1.5% protein; calcium, phosphorus; Iron; traces of vitamin B and C and vitamin A in yellow-fleshed forms, the results of this study enable us to conclude that the flesh (and leaves) of pumpkin species should be incorporated with or eaten alongside largely protein meals for the efficacious remission of diabetes.

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INTRODUCTION

Cucurbita maschata Cucurbita pepo species; Cucurbita mxima, Cucurbita mixta and Cucurbita ficifolia are annual creeping or trailing pumpkin-producing herbs which have wild and cultivated types found in tropical Africa; South and Central America; West Indies, Southern U.S.A. and South East

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Asia. In Eastern Nigeria, pumpkin fruits and leaves were generously eaten by the indigenous Igbo population as an essential vegetable adjunct to yam meals which were high-energy foods commonly eaten by the natives. Massive rural-urban migration of the 1960s caused yam dishes to be eaten neat or with oily stews made with tomatoe pulp or puree by the natives without accompanying vegetable adjuncts. A parallel tremendous increase in the incidence of diabetes in the indigenous population occurred since the 1960s and has been rising unabated every succeeding decade. Now about 60% of

the adult population has worrisome diabetes and 30% of the remaining adult population is at high risk of becoming fully diabetic because the indigenous diet is now largely carbohydrate in nature. Since diabetes is managed with both drugs and dietary control, many diabetics in the population ask for information on suitable meals to eat other than cowpeas and plantains which are the common sources of proteins and low starch diets available locally. Diabetes Mellitus is characterized by increased appetite (polyphagia); increased urination and/ presence of glucose in urine; weight loss in spite of increased appetite / increased consumption of energy-giving foods; ketosis; acidosis and coma. In diabetes there is a decrease in entry of amino acids into muscle, an increase in lipolysis and an increase in the liberation of glucose into the circulation by the liver in the face of reduced entry of glucose into various peripheral tissues. These facts about the nature of diabetes show that diabetes is essentially a food management and food utilization problem of the human body. This paper describes the mechanism of preparing a mixture of crushed pumpkin pulp and *Voandzeia subterranean* seed flour paste, as suitable meals for diabetic patients and compares the texture, particle size and protein content of *Voandzeia subterranean* seed flour meal alone and *Voandzeia subterranean* seed flour meal mixed with pumpkin flesh. Pumpkin leaves can be served with this meal as components of mixed vegetables or as wrap-around vegetables on the pumpkin- *Voandzeia subterranean* meal.

MATERIALS AND METHODS

Mature wholesome *Voandzeia subterranean* (*hypogea*) seeds from which stones and debries had been separated were soaked at 37°C for 16 hours, air dried and milled to very fine smooth powder to form the *Vondzeia subterranean* (*hypogea*) bean seed flour. *Voandzeia subterranea* bean seed flour was mixed thoroughly with $\frac{1}{10}^{\text{th}}$ of its quantity of pure grade one palm oil. This *Voandzeia subterranean* / palm oil mixture was made into a paste with cold water of room temperature of 37°C to form uniformly smooth pulp-like semisolid watery *Voandzeia hypogea* seed flour paste to which sodium chloride was added as a salt to make it tasty. Slices of vegetables like onion leaves, *Ocimum gratissimum*, other *Ocimum spp* like curry, *Luffa cylindrical* leaves or ground *Zingiber officinale* rhizome were singly or in mixtures optionally mixed into the paste. The salted *Voandzeia subterranean* seed flour paste was then deep-fried in scoops in waiting hot soya bean oil. The same process was followed in preparing and deep-frying of a volume of the cooked or ground raw flesh of *Cucurbita maschata* or *Cucurbita pepo* pumpkin and twice its volume of *Voandzeia subterranean* bean seed flour.

RESULTS

Complete mixing of the flour and palm oil changed the colour of the palm oil from red to yellowish and changed the colour of the flour from white to yellow. The presence of pumpkin flesh, palm oil, sodium chloride and 37 °C paste-preparation water changed the microstructure of the starch granules and protein aleurone grains of raw *Voandzeia subterranean* seed flour from their original shape and size to new fried paste and

cooked lipid or glycoprotein structures which were of higher protein content.



Figure 1. *Cucurbita maschata* (below) and *Cucurbita pepo* [above] (pumpkin) species used in the study



Figure 2; Meal of cooked flesh of pumpkin and vegetable salaad of sliced cabbage, carrot and green beans constitute a light vegetable fiber diet for the management of diabetes



Figure 3. A meal of cooked flesh of pumpkin, fried (or baked) cold water-prepared *Voandzeia subterranean* seed flour paste and vegetable salaad of cooked *Ocimum gratissimum*, sliced onions and a little sliced red hot pepper, salted to taste with sodium chloride; constitute a suitable vegetable fiber diet for the management of diabetes



Figure 4. A meal of cooked flesh of pumpkin, cooked warm water-prepared *Voandzeia subterranean* seed flour paste and vegetable salaad of cooked *Ocimum gratissimum*, sliced onions and a little sliced red hot pepper, salted to taste with sodium chloride; constitute a suitable vegetable fiber diet for the management of diabetes



Figure 5. A meal of fried (or baked) cold water-prepared *Voandzeia subterranean* seed flour paste into which sliced *Ocimum gratissimum* and sliced onions had been incorporated constitute a suitable vegetable fiber diet for the management of diabetes



Figure 6. A meal of fried (or baked) cold water-prepared *Voandzeia subterranean* seed flour paste into which cooked pumpkin flesh of equal amounts had been mixed together with sliced *Ocimum gratissimum* and sliced onions; constitute a suitable vegetable fiber diet for the management of diabetes. Note that the fried cake produced cold water-prepared *Voandzeia subterranean* seed flour paste into which cooked pumpkin flesh had been mixed (in Figure 6) is softer, more homogenous and more proteinous (less hard and starchy) in consistency and taste than the fried cakes produced from cold water-prepared *Voandzeia subterranean* seed flour paste alone (Figure 5).

DISCUSSION

Food Value and Pharmacological Effects of *Voandzeia subterranean* seed meal

In a survey of the nutritional and haemagglutination properties of several African seeds, seeds of *Vigna sinensis* and *Vaandzeia subterranea* Thouars (*Voandzeia hypogea*) were found to support moderate rat growth and to contain low levels of essentially non-toxic lectin. A study conducted in Ibadan, Nigeria to determine the contribution of cowpea to the total nutrient intake of residents of rural areas of Ibadan showed that cowpeas constituted 30.2% and 30.3% of the protein intake of reactor and non-reactor children of 30 months-3 years of age; in a mixed diet⁵ which shows the importance of been seed meals as protein source in Nigerian diets.

Proteins are nitrogenous compounds formed from the condensation of large numbers of amino acids which on complete hydrolysis are separated again. The proteins are the most fundamental constituent of the protoplasm of the cells of the body. The protein extracts of *Voandzeia subterranean* (L) Thouars bean seed have been noted to have a strong nutritive and cellular power as well as a softening and biofilmogenic effects; cutaneous conditioning and repair effects; anti-wrinkle effects; tightening effects; dermal protective and elastic tissue protective effects; anti-irritant effects; anti-pollution effects; anti-free radical effects; anti-UVB and anti-UVA photo-protection effects; ant-proteases effects; anti-elastases effects; anti-chollaginas effects; anti-catalase effects; anti-aging effects; hydrating effects; pacifying and cutaneous firming effects (Silvano, 2002).

Food Value of the Fruit, Leaves and Seeds of *Cucurbita species*

The flesh of *Cucurbita species* contains 0.5-1.5% protein and the flesh of *Cucurbita maxima* is richer in protein content than others. The flesh of *Cucurbita species* is also a good source of calcium, phosphorus and Iron and the mature fruit of *Cucurbita pepo* contains up to three times as much Iron as others. The flesh of all *Cucurbita species* contains traces of vitamin B and C and yellow-fleshed forms are rich in vitamin A. The edible leaves of *Cucurbita species* generally contain 2-6% protein which is more protein than is found in the fruits. They are also good sources of calcium and Phosphorous and are rich in vitamin A. The seeds of *Cucurbita species* contain 26-30% protein and 40-50% oil. They also contain carbohydrates, calcium and iron. The seeds of *Cucurbita pepo* are rich in methionine (United Nations Food and Agricultural Organization, 1988).

Food use of Fruits, Leaves and Mature Fruits of Pumpkin and Winter Squashes

The flesh of peeled mature pumpkin and winter squashes is cut into small pieces and boiled until soft. Pounded ground nuts and salt are then added to it. The flesh of peeled mature pumpkin and winter squashes are also used for making pies and making jam. In Uganda, the crushed fruit of *Cucurbitaceae species* is sundried after the seeds have been separated from the pulp and later cooked until soft (after it had been washed thoroughly) and groundnut paste is added to it to

produce a cooked sauce. Alternatively dried fish or meat to which some oilseed paste has been added is mixed into soft cooked crushed dry *Cucurbita* species' pulp to make a sauce which is served with millet bread. Pumpkin leaves are eaten as cherished leafy vegetables in many African countries. The leaves (with or without their stalks) are cooked soft and pounded groundnuts and tomatoes are added to them to produce sauce. Among the Igbos of South Eastern, pumpkin leaves are combined with other vegetables to produce a mixed vegetable soup for eating yams, cocoyams or plantains or they may be used as wrappers for pounded mellow seed cooked meal eaten as a delicacy or eaten neat with a cooked largely protein breadfruit seed meal. The seeds of *Cucurbita species* are roasted and eaten as snacks or are ground into fine pieces and used as protein thickening for vegetable soups. Where *Cucurbita species*' seeds are produced in large quantities, vegetable oil is extracted from them.

Medicinal and Pharmacological Value of *Cucurbita species*:

Momordica charantia L. is used here as an example of a *Cucurbitaceae* specie to illustrate the medicinal and pharmacological effects of *Cucurbitaceae* species. *Momordica charantia* L. is a *Cucurbitaceae* species cultivated or semi-wild in many tropical countries ,namely, India; Indonesia; Sri Lanka; Malayasia; Phillipines; China, the Carribeans; and West, Eastern and Southern Africa . It is an annual climbing herb with often pear-shaped or oblong tapering fruits of 10-25 cm in length and 5-8 cm in diameter fruits which are usually hanging. Green *Momordica charantia* fruits turn to yellow or orange when mature and split into 3 valves to expose seeds sheathed in a sticky red pulp. There are bitter and non-bitter varieties. In food use, peeled bitter fruits are soaked in salt water to remove the bitter taste and then boiled or fried or stuffed with minced meat and eaten. They are also used as flavouring in curles and pickles in India. Young sweet *Momordica charantia* L. fruits are used like cucumbers in salads in Zimbabwe. Young shoots and leaves of *Momordica charantia* L. plant are used as flavouring in Java and Philippines and are eaten like spinach in india. Seeds of ripe fruits of *Momordica charantia* are roasted and ground to a paste for use in cooking, by the Tonga while the seeds are used as condiments in India (United Nations Food and agricultural organization, 1988). Cucumin (component of *Cuurbitaceae* species parts) and Kolaviron (component of *Garcinia kola* species parts) ameliorated di-n-butylphtalate-induced Testicular Damage in Rats Farombi et al. (2007).

Use of *Momordica charantia* In Folk Medicine

Fruits, leaves and roots of *Momordica charantia* L. are long used remedy for diabetes in India and Puerto Rico. The fruits of *Momordica charantia* are considered to be soothing and a tonic and are used in rheumatism, gaut, spleen and liver disease and for fevers in India. In Brazil, *Momordica charantia* seeds are used as treatment for intestinal worms.

Chemical Constituents of Extracts of *Momordica charantia* Parts:

Chemical Constituents of extracts of *Momordica charantia* parts include: Alkaloid (momordicine); charantin; -

aminobutyric acid; Vitamin C; fatty acid; Volatile oil; Carotenoids (cryptoxanthin, B-carotene; Cucurbitacins; saponins; carbohydrates and rosmarinic acid.

Pharmacological Actions of Extracts of *Momordica charantia* Parts

Pharmacological actions of extracts of *Momordica charantia* parts include: anti-diabetic; anti-microbial; anti-diarrhoeal; anti-fertility; anti-helminthic; anti-inflammatory; anti-neoplastic; anti-oxidant; anti-tumor; anti-viral; anti-ulcer; astringent; febrifuge; vulnerary.

Anti-Diabetic effects of *Momordica charantia* Parts

Several Small scale studies reported decreases in blood glucose levels and/or improvements in the glucose-tolerance tests of diabetic patients who received various doses of bitter mellow (*Momordica charantia*) fruit, juice or powder Ng et al. (1986) Welihinda et al. (1986); Sarka et al. (1996). The fruit juice of *Momordica charantia* also significantly improved the glucose tolerance of 73% of patients who had maturity onset diabetes¹¹ while the alcoholic extract of *Momordica charantia* exhibited antidiabetic activity Sarka et al. (1996).

Other Pharmacological effects of *Momordica charantia* Parts

The leaf extract of *Momordica charantia* was found to possess immunostimulant, broadspectrum anti-microbial effects Grant et al. (1991). The fruit extract of *Momordica charantia* demonstrated anti-bacterial activity against *Helicobacter pylori* while its leaves demonstrated anti-bacterial activity against *E. coli* and *Staphylococcus aureus* Nigel H. Poulter (1980). Extract of roots of *Momordica charantia* demonstrated anti-abortion effects in females Akinyele and Akinlosotu (1987). *Momordica charantia* proteins, and -momorcharin have been reported to inhibit HIV virus in vitro while the compound momordicin demonstrated cytotoxic activity against Hodgkin's lymphoma in vivo. A hot aqueous extract of the entire *Momordica charantia* plant inhibited the development of mammary tumors in mice while an aqueous extract of the plant blocked the growth of rat prostate cancer (Khanna. 1974).

Conclusion

This study concludes that a diet which combines a high protein food, *Voandzeia subterranean* seed flour paste meal with the flesh of *Cucurbitacrae species* (pumpkin species) which are high fiber, low calorie foods is a very suitable dietary adjunct in the management of diabetes. This is because the flesh of cooked or ground raw pumpkin softened the texture of the *Voandzeia subterranean* seed flour cake; eliminated particulation of the fried *Voandzeia subterranean* seed flour paste cake; made the consistency of the cake homogenous; reduced the carbohydrate nature of the cake; increased the protein content of the cake and shorten its shelf life. The flesh of *Cucurbita species* (pumpkin species) is hereby recommended as suitable for the remission of diabetes because of its low calorie nature and the excellent excess blood glucose-lowering property of related *Cucurbitaceae* species like *momordica charantia*.

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