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Nutritional Value of Pumpkin Fruit (Cucurbita Pepo) And Its Suitability in the Management of Type II Diabetes

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Abstract

The study determined the proximate composition of pumpkin fruit (Cucurbita pepo), its chromium content and the glycaemic response of type 2 diabetic patients to its consumption. Data were collected using proximate analysis, the level of chromium, a micro-element,, was determined. Ten (10) type II diabetic patients were fed with the amount of cooked pumpkin fruit which would deliver 50g of glycaemic carbohydrate while 50g of the reference food (glucose) was dissolved in 300g of potable water (25±2ºC)and fed to them. The blood sugar was recorded at fasting level, and randomly at (30, 60, 90, 120 mins). The data were analyzed using mean as the statistical tool. The proximate analysis showed that the carbohydrate content of the pumpkin fruit was 0.5%, lipid 1.2%, fibre 2.8%, protein 2.1% , ash 1.2 % and moisture 92.2% ,(very high). The results showed that pumpkin fruit contains 0.061mg/l chromium.The results revealed that during the feeding, with the reference food, the longer the time, the more the increment in glycaemic response, while in the test food (pumpkin fruit), the longer the time, the lower the glyacemic response and the emptier the patients' stomachs became. Also the test food led to frequent urination by the patients.Pumpkin fruits cannot be used alone in the management of type II diabetes; but used in combination with other low glycaemic index (GI) foods. It was recommended that pumpkin (Cucurbita pepo) should be consumed as a component of a mixed diet by diabetic and non- diabetic individuals.

Keywords: *Diabetics, Pumpkin, Glycaemic , Carbohydrate, Fibre.*

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1. Introduction

Diabetes mellitus is a group of metabolic diseases in which the person has high blood sugar (glucose) either because insulin production is inadequate or because the body's cells do not respond properly to insulin or both **(Onyeka,2013)**. 2World Health Organization (WHO) (2013), added that diabetes is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period. **3Lambert (2002)** reported that there are four types of diabetes: (a) Type 1 Diabetes mellitus (b) Type 2 Diabetes Mellitus (c) Gestational Diabetes Mellitus (d) other types of Diabetes.

Types 2 diabetes is known as non-insulin dependent diabetes (NIDD). It is characterized by insulin resistance, which may be combined with relatively reduced insulin secretion. The defectiveness of body tissues to insulin is believed to involve the insulin receptor. Dietary factors also influence the risk of developing type 2 Diabetes. Consumption of excess sugar sweetened drinks is associated with increased risk. Saturated fatty acids increase the risk as well, while polyunsaturated and monounsaturated fatty acids decrease the risk. Lack of physical exercise is believed to cause 7% of the cases.

Tierney, Mcphee and Papdakis (2002) stated that it is important for diabetic patients to consume diets containing appropriate energy content, as this greatly influences glycemic control. 5Guideline for the nutritional management of **Diabetes Mellitus (1999)** opined that dietary management includes education about time, size, frequency or composition of meal to avoid hypoglycemia. Before prescribing a diet, it is important to know the patient's normal food pattern, besides, other dietary factors such as *methi (fenugreek),* karala *(bitter gourd) and* jamum (blackberry) have been found to help in lowering the blood glucose levels in diabetic patients especially in those belonging to the majority on-set type **(Tierney *et al*., 2000).**

In view of this, **Harrison, Resnick, Wintrobe, Adam and Beeson (2010)** emphasized three methods of treatment available for diabetic patients. These include diet alone, and oral hypoglycemic diet and insulin. Dietary measures are an essential part of treatment of diabetic patients, in order to control blood glucose, minimize the risk of hypoglycaemia, and reduce the long-term complications.

Pumpkin, a cultivar of *Cucurbita pepo*, that is commonly called (*ugbogoro*) in Igbo, is round, with smooth slight ribbed skin and deep yellow coloration. The thick shell contains the seed and pulp. The **pumpkin patch (2007)** stressed that pumpkin fruit has been evaluated in limited clinical trials, for medicals which includes anthelminthic, hypotensive and hypoglycaemic activities. It is an excellent source of fibre, which helps to protect the body against heart disease, control blood sugar levels, promote healthy digestion and play a role in weight loss. It is one of the most nutritious fruits available, packed with disease-fighting nutrients; it also offers numerous health benefits through the provision of the alpha-carotene and beta-carotene.There is a potent antioxidant found in pumpkin , provitamin A, (carotenoids) which is converted in the body as Vitamin A **(The pumpkin patch, 2007).**

Pumpkins promote healthy vision and ensure proper immune function. The beta–carotene in pumpkin may also reverse skin damage caused by the sum and acts an anti-inflammatory. It also helps in normalizing heart function and manage stress. **(The pumpkin patch, 2007).**

Hyperglycaemia can be reversed by variety of measures and medication to improve insulin sensitivity or reduce glucose production by the liver. As the disease progresses, the impairment of the insulin secretion worsens and the therapeutic replacement becomes necessary. Diabetes Mellitus is usually first treated by increasing physical activity in the case of obese patients, those affected are people living a sedentary life style, increasing intake of carbohydrate and gaining of weight. However, the underlying tendency to insulin resistance is not lost and so attention to diet must continue **(Cash, 2014).** It is against this background that this study intends to investigate the nutritional value of pumpkin fruits and its relationship with the management with the management of Type 2 Diabetes.

Diabetes is a common disease in Nigeria. From 2012 to 2014, diabetes is estimated to have resulted in 1.5 to 4.9 million deaths each year **(World Health Organization,2013).** Generally, treatment of this condition is available, but because of ignorance and misinformation, sufferers do not take advantage of the good management. The adverse effect of this includes disabilities and death among sufferers. These have

far-reaching consequences on the sufferer, family and society at large. This constitutes the motive for this work.

The main purpose of this study is to investigate the nutritional value of pumpkin fruit and its relationship with the management of Type 2 Diabetes. Specically, it determined the proximate composition of pumpkin fruit;found out its chromium content ;and also determined the glycaemic response of Type 2 diabetic patients to consumption of pumpkin fruit.

2. Materials, Subjects and Methods

Materials

Mature and fresh pumpkin fruits were harvested from Ifakala in Mbaitoli L.G.A. of Imo State

Subjects

Ten (10) type 2 diabetic human subjects, aged between 40 and 60 years (3 males and 7 females) were selected from some communities in Mbaitoli L.G.A. of Imo State. With the help of their physician, the subjects were verbally appraised and they gave their informed consent by willingly filling a consent form. Their body mass index (BMI) was in the range of 25.0-30.0 (obese, grade 1). The study adhered strictly to the World Medical Association Declaration of Helsinki. The medical aspect of the study such as taking blood samples was done by trained professionals-qualified medical laboratory scientists. The privacy of the subjects was respected.

Preparation and cooking of the fruits

The mature and fresh pumpkin fruits selected were peeled and sliced while the seeds were separated from the pulp. They were boiled for 1hour until cooked. They were allowed to cool before serving.

Proximate Analysis

Moisture, crude protein, fat and ash were determined. Priot to that, 100g of the cooked pumpkin fruit was weighed and dried at 60ºC using an oven (Gallen Kamp), until a constant weight was obtained (AOAC,2000). Moisture content of the fruit was determined by measuring the weight of the dried sample. Crude protein was estimated by micro-kjeldahl method. Crude fat was determined by extracting the fruit sample with petroleum ether using a soxhlet apparatus. Ash was determined by oven-drying the sample at 105 ºC and thereafter placing the sample into a tarred porcelain crucible and transferring it into a muffled furnace at 600 ºC for 4h to obtain ash. Total dietary fibre (TDF) was obtained from literature (Srilakshmi,2011) while glycemic carbohydrate was determined by difference: % Carbohydrate = 100 - % (Moisture + Ash + Protein + Fat + Total dietary fibre).

Chromium (Cr)

Chromium was determined by diphenylcarbohyraz method using H 183200 multi-parameter branch photometer wavelength of 525mm. 10ml of the sample was poured into two (2) separate sample cell bottles. One was used as blank to zero the photometer and one (1) sachet of H193723 -0 reagent was added to the second sample cell bottle and was swirled to mix properly. It was then inserted into the cell compartment and timed to 6 minutes. At the end of the countdown, the red bottom was pressed to display the result mg/L of Chromium.

The amount that would deliver 50g glycaemic carbohydrate from the cooked fruit was calculated using the data from proximate analysis. Hence, the measured portion of the pumpkin fruit was served to the diabetic subjects; it was done for 2 days. Each of the subjects was also fed 25g glucose (reference food) in 300ml potable water (25± 2 ºC).

Determination of Blood Glucose of the subjects

Capillary pricked-finger blood samples were taken at baseline (0 min), 30, 60, 90 and 120 min after consumption of the cooked pumpkin fruit sample and glucose solution- 50g in 300ml of potable water (25±2º C) (reference food). Each blood sample was placed on a test strip which was inserted into a calibrated Glucometer (Accu-Check), which gave direct readings after 5 seconds. The incremental areas under the glycaemic response curve (IAUC) were calculated geometrically (Wolever and Jenkins,1986). The GI was calculated by expressing the glycaemic response area for the cooked pumpkin sample as a percentage of the mean response area of the glucose solution by the same subjects. The formula stated below was applied:

GI = Area under the curve for 50g carbohydrate from test food x 100

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Area under the curve for 50g carbohydrate from glucose

The final glycaemic index of the pumpkin fruit sample was calculated as the mean from the respective average glycaemic indices of the subjects.

3. Results

Table 1: Proximate composition of Pumpkin fruit.

Common name	Botanical name	CHO (g 100^{-1}g)	Moisture (g100^{-1}g)	Lipid (g100^{1}g)	Protein (g100^{1}g)	Ash (g100^{1}g)	TDF (g100^{1}g)
Pumpkin fruit	*Cucurbita pepo*	0.5	92.2	1.2	2.1	1.2	2.8

Key: CHO =Carbohydrate; TDF = Total dietary fibre

Table 1 above shows the proximate composition of pumpkin fruit. The carbohydrate content is 0.5%, ash 1.2%, fibre, 2.8%, lipid 1.2%, protein 2.1% and moisture content 92.2%, which is very high.

Table 2: Chromium content of Pumpkin fruit

Mineral	Content in mg/dl	Content in microgram
Chromium (Cr^{6+})	0.061mg/dl	61µg/dl

Calculation of Glycaemic Index of Pumpkin fruit.

G.I = Area under the curve for 50g CHO for test food x 100
Area under the curve for 50g of glucose (reference food)

$$\frac{28.0}{228.8} \times \frac{100}{1} = 12.24$$

GI = 12.24

Table 3: Mean Blood Glucose Concentration (mg/dl) of Subjects

Reference food/Pumpkin	Baseline (0min)	30 min	60 min	90 min	120 min
Reference(Glucose solution	109.6	130.5	152.5	173.6	192.5
Pumpkin fruit(*Cucurbita pepo*)	124.68	121.89	130.03	133.65	133.15

Values are means ± standard deviations of the means of the subjects

Table 4: Percentage (%) Increment/ Decrease in Post-prandial Blood Glucose of Subjects

Reference food/Pumpkin	Baseline (0min)	30 min	60 min	90 min	120 min
Reference (Glucose solution)	0.0	19.07	39.14	58.39	75.64
Pumpkin fruit (*Cucurbita pepo*)	0.0	-2.24	4.29	7.19	6.79

4. Discussion

The result of the proximate analysis on pumpkin fruit showed that it has 2.8% total dietary fibre (TDF) ,1.2% fat, 1.2% ash, 0.5% carbohydrate; 2.1% protein, and moisture content of 92.2%, which signifies that pumpkin fruit is very high in moisture content. Due to extremely low quantity of glycaemic carbohydrate present, it does not supply much glucose to generate energy to the body system. In relation to dietary management of diabetes mellitus, the carbohydrate content falls short of the needed amount for energy, meaning that pumpkin cannot in any way form whole food for diabetic patients. **Joshi (2010)** stated that carbohydrate should provide about 55% of energy intake of diabetic patients; they need therefore, to be complemented with other foods to meet calorie requirements.

The durability of digestion is short due to low fibre content, thus it cannot supply the fibre needed for diabetic patients. According to **Berliman, Robert and Hall (2010)**, diabetic patients need to consume 20 – 35% fibre daily in other to get the benefits. The fibre present in pumpkin is very low. Lipid content is also low, though the diabetic should not exceed 150mg per day (Joshi, 2010)

Protein content is very low in comparison with the level needed. **Joshi (2010)** stated that diabetic patients on average consume more protein than non-diabetics and exclusive protein consumption is linked with diabetic nephropathy. Moisture content is very high; it can act as an anti-diuretic and help to avoid other related diabetic diseases. This finding is in accordance with the report of **Ashoke, *et al.*, (2013)** that pumpkin fruits possess anti-diuretic and anti-hyperlipidemic effect and is able to ameliorate the diabetic state.

The result in Table 2 shows that Chromium is low in comparison with the level needed i.e., 1000 - 1500µg. Institute of Medicine, a component of **National Academy of Science (2006)**, equally stated that adequate daily intake of Chromium needed for diabetic patients ranges from1000 - 1500µg per day. Chromium is needed in trace amount in human body to help process carbohydrate, protein and fat. Most importantly, it enhances the action of insulin.

Tables 3 consists of the mean blood glucose concentration of the subjects in response to consumption of the test food and reference food while Table 4 reveals the percentage increment/decrease in post- prandial blood glucose concentration of the subjects with respect to the test food and the reference food. The reference food elicited a mean of 75.64% increment in the blood glucose concentration of the diabetic subjects at 2h post-prandial period while the test food (pumpkin fruit) led to as little as 6.79% within the same period. This result is obviously attributed to the extremely low content of glycaemic carbohydrate, very low total dietary fibre (TDF), and very low fat. The test food, which is pumpkin has a very low glycaemic response compared with reference food (glucose) as a result of very low CHO, protein and lipid.

This very low increment in the blood glucose concentration is healthy for the diabetic subjects since it does not represent a further increase in the already high blood glucose level, leading possibly to hyperglycaemia.

An interesting aspect of the result as shown in Table 4 is that 30 min after consumption of the pumpkin fruit, a decrease in the blood glucose concentration was observed. Hence, it lowered blood glucose concentration by 2.24% after 30 min. This decrease could be attributed to the fact that the first stage of energy metabolism (glycolysis) expends some energy in the form of ATP, which invariably would have been supplied by the glycolysis occurring at the fasting level **(Sharon et. al.,2006)**. There was, on the other hand, an increment after an hour, which steadily increased at 7.19% until it decreased at 6.79%. This result represents a steady but little increment in the blood glucose concentration of the subjects.

This result further revealed that, in glucose, the longer the time, the more the increment in the glycaemic response, while in the test food, the longer the time, the lower the glycaemic response and the emptier the subjects' stomachs became, due to very low glycaemic carbohydrate and total dietary fibre contents. Also the test food leads to frequent urination as a result of very high moisture content (92.2%) Earlier studies done by **Ashoke *et al*, (2013)** showed that pumpkin fruit has some anti-hyperlipidemic and diuretic substance. This statement is confirmed in the result obtained from the study.

5. Conclusion and Recommendations

Although diabetes mellitus is a serious and costly metabolic disease, some dietary measures

can be used in managing the disease. Obviously, pumpkin fruit cannot be used alone to manage Type II Diabetes, rather it can serve as one of the components of the mixed diabetic diet, in order to avoid hypoglycaemia. The following recommendations were made in this study:

- Pumpkin fruit should be consumed by diabetics and non-diabetics.
- Farmers and home gardeners should be encouraged to cultivate pumpkin to ensure its availability all year round.
- It is encouraged that students, researchers and professionals in Nutrition, Agricultural Sciences, Botany, etc should carry out more research on health and nutritional benefits of pumpkin fruit.
- It is recommended that Home Economists, Nutritionists, Dieticians; should create awareness on causes, consequences, and dietary management of diabetes so as to educate people more appropriately and enhance better management of the condition.

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