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Chemical Evaluation of Unripe Plantain Dishes Commonly Consumed by Type 2 Diabetics Attending the University of Uyo Teaching Hospital in Akwa Ibom State, Nigeria

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Abstract: This study evaluated the chemical composition of unripe plantain dishes commonly consumed by Type-2 diabetics attending the University of Uyo Teaching Hospital, Akwa Ibom, Nigeria. Groups of type 2 diabetic patients were engaged in a focus group discussion to identify the plantain dishes commonly prepared and their recipes. The groups mentioned many plantain dishes but five of them were randomly selected for preparation. The ingredients for preparation of the unripe plantain dishes were purchased from a market in Uyo. The proximate, mineral and antinutrient composition of the dishes were analyzed using standards methods. Means and standard deviation of the triplicate determination was determined and analysis of variance was used to separate the means. The results showed that Unripe plantain flour had the highest carbohydrate content (76.96%) while unripe plantain flour meal with vegetable soup had the highest protein and ash content. All the plantain dishes had low levels of minerals. The saponin (2.54%) and tannin (0.08%) levels of the unripe plantain flour was the highest when compared with the other plantain dishes. There is need to educate the diabetics on the nutrient content of plantain based dishes and encourage them to diversify their diets.

Key words: Chemical, evaluation, plantain-based, dishes, diabetics

INTRODUCTION

The incidence and prevalence of type 2 diabetes has continued to increase globally, despite a great deal of research, with the resulting burden resting heavily on tropical and developing countries (Wild *et al.*, 2004; Lindagren and Hirschorn, 2001). Available data suggests that type 2 diabetes is fast emerging as a major health problem in Africa (Mbanya *et al.*, 1996). Diabetes mellitus is the leading cause of kidney failure, non-traumatic lower limb amputations, blindness, heart disease, stroke and deaths. Recent estimates indicate that the total number of patients affected by diabetes in 2004 was close to 190 million. Over 30% of our elite population are diabetics. More painfully so, the majority of the Nigerian diabetic population cannot afford meaningful treatment. World health Organization, reported that at least 171 million people worldwide suffer diabetes. It is estimated that by 2030, this number will almost double (Gupta *et al.*, 2010).

The Nigeria Diabetes Association (2010) reported that about 6 million Nigerians are estimated to be living with diabetes mellitus. According to experts, nutritional habits play a decisive role in increasing the burden of chronic conditions (including type 2 diabetes). Therefore modifying dietary habits could exert a positive impact in the prevention and treatment of these chronic diseases (Ikewuchi and Ikewuchi, 2009). Dietary management of type 2 diabetes mellitus has been helpful and such diets

used to manage type 2 diabetes in Nigeria include beans (cowpea), African yam bean, breadfruits and unripe plantain (Eleazu *et al.*, 2010).

Plantains (*Musa paradisiaca*) is an important staple food in Central and West Africa, which along with bananas provides 60 million people with 25% of their calories (Adetuyi *et al.*, 2012). According to FAO, over 2.11 million metric tons of plantains are produced in Nigeria annually. However, about 35-60% post harvest losses had been reported and attributed to lack of storage facilities and inappropriate technologies for food processing (Adetuyi *et al.*, 2012). When processed into flour it is used traditionally for preparation of gruel which is made by mixing the flour with appropriate quantities of boiling water to form a thick paste. The use of plantain flour for production of baked goods if feasible would help to lessen our total dependence on imported wheat.

Plantains (*Musa paradisiaca*) are widely grown in Nigeria, particularly the eastern part of the country. Unripe plantain dishes are usually consumed by Nigerian diabetics to reduce post-prandial blood glucose level (Foster *et al.*, 2003). According to Rambdath (2004), this is because unripe plantain is a low glycemic index food since it contains starch that has only small concentrations of sugar and these sugars are released slowly over time. In Nigeria, unripe plantain pulp could be eaten boiled, fried, or roasted. It is also commonly made into chips by frying thin slices in oil and

salting it. Roasted unripe plantain (called 'bole' in the Western part of Nigeria) is prepared by roasting unripe plantain pulp over balls of red-hot coal until it is cooked. This is then eaten with any traditional Nigerian soup. Boiled unripe plantain is either eaten with sauce, or pounded into 'foo-foo' and eaten with any Nigerian soup. Unripe plantain pulp is also dried, ground into flour. This flour may be reconstituted in boiling water to make 'amala' which is eaten with any Nigerian soup. The flour is also used for several other traditional dishes ranging from 'akara', 'ukpo ogede' and soups. Thus the objective of this work was to carry out the chemical evaluation of unripe plantain dishes as consumed by type 2 diabetics attending the University of Uyo Teaching Hospital in Akwa Ibom State, Nigeria.

MATERIALS AND METHODS

Source of materials: The ingredients for preparation of the unripe plantain dishes were purchased from a market in Uyo. They included unripe plantain fruit, unripe plantain flour, beef, stockfish, dried fish, fresh pepper, crayfish, pumpkin leaves, water leaves, scent leaves, periwinkle, palm oil, salt and knorr cubes.

Selection of the dishes: Groups of type 2 diabetic patients were engaged in a focus group discussion to identify the plantain dishes commonly prepared and their recipes. The groups mentioned many plantain dishes but five of them were randomly selected. The plantain dishes selected were: Unripe plantain pottage, unripe plantain pepper soup, unripe plantain pulp, boiled and pounded unripe plantain with vegetable soup and unripe plantain flour *foo-foo* with vegetable soup.

Preparation of the dishes

Unripe plantain pottage: Ingredients used were unripe plantain fruit, unripe plantain flour, beef, dried fish, fresh red pepper, crayfish, pumpkin leaves, water leaves, scent leaves, periwinkle, palm oil, salt and knorr cubes. Method of preparation: (i) The unripe plantain was skinned and the pulp was diced into cubes (ii) Water was placed into a pot and brought to boil (iii) The diced plantain was added into the pot and seasoned with a little salt and knorr cubes. (iv) Ground fresh pepper, crayfish and onions was allowed to boil for 3 min (iv) Dry fish and cooked stock fish and periwinkle was added. The contents of the pot was covered and brought to boil for another 10 min. (v) Palm oil, pumpkin leaves and scent leaves was added and covered for 3 min. The heat was turned off and the contents of the pot mildly turned to mix.

Unripe plantain pepper soup: Ingredients used were unripe plantain pulp, scent leaves, dried fish, fresh red pepper, onions, knorr cubes and salt. Method of preparation: (i) Unripe plantain was skinned, cut in halves and put in a pot with enough water to cook it. (ii) The contents of the pot was seasoned with little salt and

knorr cubes. (iii) Ground fresh pepper, sliced onions and scent leaves was added and stirred. (iv) Dried fish and a table spoon of vegetable oil was added and allowed to simmer for 5 minutes. NB: This dish was prepared in such a way that at the end of the preparation, there was enough water with which to eat the unripe plantain.

Unripe plantain pulp: Unripe plantain fruit was washed and the skin peeled off.

Boiled and pounded unripe plantain: Method of Preparation: (i) Unripe plantain fruit was skinned, cut into pieces and cooked in a pot of water until done (ii) The cooked unripe plantain was then removed from the boiling water, put in a deep wooden mortar and pounded to obtain a smooth consistent paste. (iii) Hot water was added intermittently with pounding to obtain the desired texture.

Unripe plantain flour meal (foo-foo): The unripe plantain flour meal was prepared by stirring continuously 225 g flour in a pot of 250 mL boiling water until well cooked to form a thick, smooth brown paste.

Vegetable soup

Ingredients: Pumpkin leaves, water leaves, beef, dried fish, stock fish, crayfish, periwinkle, fresh red pepper, onions, palm oil, knorr cubes, salt. Method of preparation: (i) The beef was washed thoroughly and placed in a pot (ii) Some sliced onions, ground fresh pepper and 50 mL of water was added to cook for 30 min (iii) Washed periwinkles, stock fish and dried fish were added to the pot and cooked for another 10 min. (iv) Finally, the shredded pumpkin leaves, ground crayfish and palm oil were added, mixed properly and allowed to simmer for 5 min.

Chemical analysis: The moisture, ash, fat, protein and crude fibre content of the samples were determined using the method of AOAC (1995) methods. Carbohydrate content was obtained by difference i.e., Percentage carbohydrate = 100-(moisture, ash, fat, protein and crude fibre). The AOAC (1995) standard methods were also used to determine iron (using phenanthroline method), calcium and magnesium. Saponin was determined by the method of Harborne (1973) and Pearson (1976) method was used to determine tannin.

Data analysis: The laboratory analyses were carried out in triplicates. The mean and standard deviation were calculated. Analysis of Variance (ANOVA) was used to separate the means.

RESULTS

Table 1 shows the proximate composition of plantain based dishes. Sample UPF1 had the highest carbohydrate content (76.96%) which was significantly

Table 1: Proximate composition of plantain-based dishes

Samples	Carbohydrates	Protein	Fat	Fiber	Ash	Moisture
UPF1	76.96±0.01 ^a	2.23±0.00 ^a	2.14±0.00 ^a	0.71±0.00 ^a	2.43±0.00 ^a	15.41±0.00 ^a
UPF2	19.66±0.01 ^a	3.74±0.00 ^a	2.24±0.00 ^b	0.57±0.00 ^a	2.43±0.00 ^a	72.48±0.00 ^a
UPP1	23.12±0.01 ^a	2.48±0.00 ^a	2.37±0.00 ^a	0.57±0.07 ^a	1.84±0.00 ^b	69.83±0.00 ^a
UPP2	20.47±0.01 ^d	3.44±0.00 ^b	2.14±0.00 ^a	0.69±0.00 ^a	1.64±0.00 ^b	71.64±0.00 ^a
UPP3	39.69±2.08 ^b	2.38±0.00 ^d	2.18±0.06 ^a	0.49±0.00 ^d	1.23±0.00 ^d	53.83±2.08 ^d
BPUP	20.66±0.01	3.44±0.00 ^b	2.24±0.00 ^b	0.69±0.00 ^a	1.64±0.00 ^b	71.64±0.00 ^a

Mean±Standard deviation of three determination
 UPF1: Unripe plantain flour
 UPP1: Unripe plantain pottage
 UPP3: Unripe plantain pulp

Mean values with different alphabets in the same column are significant (p<0.05)
 UPF2: Unripe plantain flour meal with vegetable soup
 UPP2: Unripe plantain pepper soup
 BPUP: Boiled and boiled unripe with vegetable soup

Table 2: Mineral composition of the plantain-based dishes

Samples	Calcium (mg/100 g)	Magnesium (mg/100 g)	Iron (mg/100 g)	Potassium (mg/100 g)
UPF1	0.44±0.00 ^a	0.72±0.00 ^b	0.19±0.00 ^a	73.25±0.02 ^a
UPF2	0.32±0.00 ^a	0.48±0.00 ^d	0.31±0.00 ^a	51.34±0.02 ^b
UPP1	0.39±0.00 ^a	0.99±0.00 ^a	0.19±0.00 ^a	76.25±0.03 ^a
UPP2	0.37±0.00 ^b	0.49±0.00 ^d	0.18±0.00 ^a	48.75±0.02 ^c
UPP3	0.39±0.00 ^b	0.49±0.00 ^d	0.25±0.00 ^a	35.27±0.02 ^d
BPUP	0.39±0.00 ^b	0.52±0.00 ^c	0.16±0.00 ^d	26.74±0.02 ^e

Mean±Standard deviation of three determination
 UPF1: Unripe plantain flour
 UPP1: Unripe plantain pottage
 UPP3: Unripe plantain pulp

Mean values with different alphabets in the same column are significant (p<0.05)
 UPF2: Unripe plantain flour meal with vegetable soup
 UPP2: Unripe plantain pepper soup
 BPUP: Boiled and boiled unripe with vegetable soup

Table 3: Antinutrient composition of the plantain-based dishes

Samples	Tannin (mg/100 g)	Saponin (mg/100 g)
UPF1	2.54±0.00	0.08±0.00
UPF2	1.78±0.02	0.08±0.00
UPP1	1.89±0.05	0.08±0.00
UPP2	2.26±0.00	0.07±0.00
UPP3	1.80±0.00	0.05±0.00
BPUP	1.80±0.00	0.14±0.00

UPF1: Unripe plantain flour
 UPF2: Unripe plantain flour meal with vegetable soup
 UPP1: Unripe plantain pottage
 UPP2: Unripe plantain pepper soup
 UPP3: Unripe plantain pulp
 BPUP: Boiled and boiled unripe with vegetable soup

(p<0.05) different from the other dishes. The samples UPF2 had the highest protein (3.74%) and fat content (2.37%) when compared with other dishes. Samples UPF1, UPP2 and BPUP had comparable fibre values.

DISCUSSION

The low levels of protein, fibre, fat, ash and carbohydrates in all the plantain based dishes except unripe plantain flour were because of the high moisture contents. It is not surprising the unripe plantain flour had the least moisture value. This is because the method of processing the flour is drying which limited the moisture content. It is known that the higher the moisture contents of a given food, the lower is the nutrient density (Micheal, 2011). Moisture content had an inverse effect on carbohydrate content. This was in accordance with the findings of Oboh and Erema (2010). Fat, ash and crude fibre content were low in all the plantain based dishes. This agrees with literature which states that unripe plantain is low in minerals. The comparable values of these nutrients in most of the dishes reveal that any of the dish can be used in supply of these nutrients. The unripe plantain flour meal with vegetable soup had higher iron (0.31 mg/100 g) than all the other dishes

while the unripe plantain had higher potassium (76.25 mg/100 g) and magnesium (0.99 mg/100 g) content when compared with the other dishes. The tannins and saponin content of these dishes were within the safe level for consumption. Many diabetic patients take these meals on a daily basis with the understanding that plantain based dishes when consumed reduce or even maintain the blood sugar level. These plantain based dishes were high in carbohydrates and low in fibre making them alone not adequate in the management of diabetes. The mineral contents of these dishes were below the requirement of a normal healthy individual at all ages and not sufficient for the diabetics. According to Michael *et al.* (2010), diabetic mellitus patients are encouraged to choose a variety of fibre-containing foods such as whole grains, fruits and vegetables because they provide vitamins, minerals, fibre and other substances important for good health. In subjects with type 2 diabetic mellitus, the ingestion of very large amounts of fibre is necessary to confer metabolic benefits on glycaemic control, hyperinsulinemia and plasma lipids, the volume of which may be unacceptable to most people.

Conclusion: These plantain based dishes commonly consumed by the diabetic patients in the hospital studied contained a good nutrient profile but are not adequate in meeting the nutritional needs of the patients. They had low levels in protein, fats, fibre, iron, magnesium and potassium and their antinutrients (saponin and tannin) contents were within their safe levels. There is need for registered dietitians to educate the diabetic patients on the health consequences of monotonous diet and encourage them to diversify their diets for better health.

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