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Study of Sweet Potato (*Ipomea batatas* Lam) Foods for Indigenous Consumption Through Chemical and Anti-Nutritive Analysis in Kwara State, Nigeria

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Abstract: Production of indigeneous cheap and nutritious food which will improve the general health and well-being of people is inevitable. For a clear assurance of producing rich food devoid of antinutritive components and of course with high nutritive value, two samples of sweet potato foods; Sweet Potato Leaf Soup (SPLS) and Sweet Potato and Yam Pounded (SPYP) were prepared and analyzed for nutritional, minerals and antinutrtional contents. The result of nutrient content indicate that the percentage concentration of moisture, protein, fat, ash, crude fibre and carbohydrate were 70.54, 12.21, 3.88, 8.83, 5.88 and 25.74 for SPLS and 35.15, 1.42, 0.52, 1.49, 0.67 and 68.37 for SPYP respectively. The result of mineral content indicate the concentrations (mgg^{-1}) of iron, zinc and calcium to be 8.82, 0.09 and 27.99 for SPLS and 1.61, 0.12 and 20.33 for SPYP respectively. Antinutritional result indicate that the concentration (mgg^{-1} of phytate, oxalate and tannin were 1.07, 167.16 and 0.22 for SPLS and 0.93, 171.93 and 0.56 for SPYP respectively. The result revealed significant difference ($p<0.05$) between the nutritional value of sweet potato leaf soup and sweet potato and yam pounded dishes. The results generally indicate that sweet potato dishes if properly processed and cooked could be a high quality and cheap source of energy rich food that could improve the general health and wellbeing of people.

Key words: Sweet potato, food, indigenous consumption, nutritional composition, antinutrtional composition

INTRODUCTION

Nigeria is witnessing an increase in population growth; National Population Commission (NPC, 2006) estimated it to be 140,003,542. High population without corresponding increase in food production and availability to the citizenry can lead to household food insecurity. This is an issue possing serious nutritional problem in Nigeria, particularly among children and mothers of child bearing age. The resultant effect can lead to malnutrition, retardation in growth and development of the children and low productivity level among the mothers (Ward-Law and Kessel, 2002). Maziya-Dixan *et al.* (2003) estimated the level of mal-nutrition in Nigeria to about 76% in children. The survey revealed that 42% of children are stunted, 25% underweight and 9% wasted. The study also revealed that 16.4% of the women malnourished were from dry savannah, 9.9% moist savannah and 9% from humid forest. The problems of low level of food production coupled with low socio-economic capacity of people led to the campaign for increase production, utilization and consumption of traditional foods (sweet potato) among the citizenry (FAO, 1986). The sweet potato is one of the traditional tuber crop adaptable to wide ecological range with relatively short growing season and of high yield potential even on infertile soil (Hahn, 1984).

Previous literatures (Scott and Maldonado, 1999; O'Hair, 1984; Ojeniyi and Tewe, 2001) revealed the nutritive value of sweet potato tubers in term of carbohydrate content and hence good source of energy. It has also been reported (Hiroshi *et al.*, 2000; Ifon and Bassir, 1979) that sweet potato leaf contained protein and crude fibre which are important for addressing protein deficiency diseases and colon diseases. Other studies also revealed that both sweet potato tuber and leaf contain micro nutrients necessary for healthy body and in addition contain antinutrients, such as phytate, oxalate and tannin (Osagle, 1998; Fleming, 1981 and Udoession and Ifon, 1990). The antinutrients are capable of affecting the digestion system and availability of the nutrients to the body. Hence, in order to achieve the expected success in the campaign, for increase production, utilization and consumption of traditional foods, the nutritional and antinutritional composition of the locally available tuber crops must be known by the people.

The present study aim at exposing sweet potato to processing and cooking by using it to produce two dishes and evaluate the nutritional and antinuritional values of the dishes. It is expected that processing and cooking will reduce the level of antinutrient contents and improve the nutritional values to the body system

MATERIALS AND METHODS

Collection and treatment of samples: Raw sweet potato tubers and leaves were purchased from the open markets in Kwara state. The tubers and leaves were prepared into commonly consumed dishes by the people using the standardized recipes for the preparation of foods. The prepared dishes were Sweet Potato Leaf Soup (SPLS) and Sweet Potato and Yam Pounded (SPYP). All samples were oven dried at 65^{o}C to constant weight. The sample was ground and stored in polythene container for analysis.

Determination of nutritional content: The samples were analyzed for proximate composition (moisture, crude protein, fat, ash, crude fibre and carbohydrate). The moisture content of the samples were determined by oven drying to a constant weight at 105^{o}C. The fat content was extracted with petroleum ether (40-60^{o}C) using a soxhlet apparatus for 6 h. The Micro-Kjedahl procedure was adopted for the determination of protein. Carbohydrate was determined difference (AOAC, 2005). All proximate composition were analyzed in triplicate and reported as mean +standard deviation (SD) on % dry weight basis.

Determination of mineral content: Iron, zinc and calcium were determined after triple acid digestion according to the method described elsewhere using Atomic Absorption Spectrophotometer Model 200, Germany (AOAC, 2005).

Determination of antinutrient content: Phytate was quantified using the method described by Ola and Obah (2000). Total oxalate was determined using the method described by Krishna and Ranjhan (1980) and Association of Official Analytical Chemist (AOAC, 2005). Tannin was determined spectrophotometrically by the acidified vanillin method as described by Burns (1971) and modified by Chang *et al.* (1994).

Statistical analysis: All data collected were subjected to analysis of variance (ANOVA). All the determinations were made in three triplicates and the difference among the means were tested for any significant difference at 5% ($p<0.05$).

RESULTS AND DISCUSSION

The proximate composition of the two sweet potato samples is presented on Table 1. The samples showed significant difference in values ($p<0.05$) of moisture, protein, fat, ash and crude fibre contents of Sweet Potato Leaf Soup (SPLS) to that of the Sweet Potato and Yam Pounded (SPYP). The value of moisture content of SPYP (35.15%) compare to that of SPLS (70.54%) may likely be due to the time of harvest. However, the low value has the advantage of been able to be kept for longer time more than SPLS sample without growing moldy (Temple *et al.*, 1996). The ash content were found to be 8.83% and 1.49% for SPLS and SPYP respectively. These values could be adjudged to be a measured of good source of minerals. The organic matter content was found to be 91.19% for SPLS and 98.51% for SPYP respectively. Organic matter measure the nutritional value (lipids, protein and carbohydrate) of a plant material. The high values indicate that the two dishes are good sources of nutrient. The protein, lipid, crude fiber and carbohydrate were found to be 12.21, 3.88, 5.88 and 25.74% for SPLS and 1.42, 0.52, 1.49, 0.67 and 68.37% for SPYP respectively (Table 1). These values indicate that the two dishes from sweet potato could be a good source of carbohydrate and fiber. High and relatively high carbohydrate and fiber also indicate that the sweet potato dishes could a great source of energy and could help treat constipation and hence improve the general health and well being. The result of the proximate analysis have revealed that sweet potato samples were rather low in protein contents as compared to recommended daily requirement of 45-50 g of protein a day for a healthy person (Fisher and Bender, 1972). High content of protein is observed in the leaf sample in this work which is in conformity with Hiroshi *et al.* (2000). Most plant foods have poor and incomplete protein. It is desirable that plant foods should be consumed along with animal foods. This will enhance the nutritive value of the sample foods. So the addition of animal products in the preparation of the samples is a serious point that should be considered in order to reduce the malnutrition level in the society. However, the carbohydrate content of the tuber samples was higher than that of the sweet potato leaf soup. The values compared favourably well with the amount (18-32 g) per day for an average man as reported by Anhwange (2008).

The low fat content in SPYP compare with SPLS and high fat content in SPLS compare with SPYP have been reported (Velmurugu *et al.*, 1995; Hiroshi *et al.*, 2000; Ojeniyi and Tewe, 2001 and Antia *et al.*, 2006), however the consumption should be encouraged since it is type of fat that is easily used by the body system.

The crude fibre content of SPYP (0.67%) is lower comparing to SPLS (5.88%) samples. The results is supported by the work of Hiroshi *et al.* (2000). Crude fibre in the leaf sample contributed a higher percentage and makes the leaf very important because of its role in the prevention and treatment of diseases such as obesity, diabetes, cancer and gastro intestinal disorders (Saldanha, 1995). There is also evidence that dietary fibre improves glucose tolerance and is therefore beneficial in treating maturity pre-set diabetes (Olusanya, 1991).

The result of the mineral content of the samples (Table 2) shows the concentration of iron, zinc and calcium with the concentration of calcium relatively higher in both samples (27.99 mg/g for SPLS and 20.33 mg/g for SPYP). The zinc contents in all the samples were

Table 1: Proximate composition of sweet potato samples

Food sample	Moisture %	Protein %	Fat %	Ash %	Crude Fibre %	Carbohydrate %
SPLS	70.54±0.55[b]	12.21±0.11[a]	3.88±0.01[a]	8.83±0.16[a]	5.88±0.10[b]	25.74±1.09[d]
SPYP	35.15±1.19[e]	1.42±0.03[f]	0.52±0.01[d]	1.49±0.06[cd]	0.67±0.00[e]	68.37±1.50[ab]

Means along the same column with different superscript are significantly different ($p<0.05$)

Table 2: Mineral content (mg/100 g) of sweet potato samples

Food sample	Iron (Fe) (mg/100g)	Zinc (Zn) (mg/100g)	Calcium (Ca) (mg/100g)
SPLS	8.82±0.05[a]	0.09±0.02[d]	27.99±0.56[b]
SPYP	1.61±0.05[c]	0.12±0.00[ed]	20.33±0.79[e]

Means of triplicate date in the same column with different superscript are significantly different ($p<0.05$)

Table 3: Phytate, oxalate and tannins content of sweet potato samples (100 g)

Food sample	Phytate mg/100g	Oxalate mg/100gm	Tannin mg/100gm
SPLS	1.07±0.04[a]	167.16±1.19[b]	0.22±0.02[c]
SPYP	0.93±0.01[b]	171.93±4.81[b]	0.56±0.01[ab]

Means along the same column with different superscript are significantly different ($p<0.05$)

generally low; 0.09 mg/100g for SPLS and 0.12 mg/100g for SPYP respectively and Iron concentration being moderate 8.82 mg/100g and 1.61 mg/100g for SPLS and SPYP respectively. It should be noted that the value of iron in plant foods should not be evaluated for its availability to the body. This is because of the intestinal absorption rate of heme-iron and non-heme iron that was clearly stated by Bjorn *et al.* (1974) as 37% for heme-iron and 5% for non-heme iron. It has been reported (Hallberg *et al.*, 1979) that about 90% of iron taken as foods in developing countries is non-heme. Litter and River (2003) also reported that the absorption rate of non- heme iron is enhanced with intake of vitamin C foods. The low content of zinc in these in these samples should be discouraged because of its benefits to the body system (Mahan and Stump, 2004). The moderately high content of Calcium in both samples has been reported (Ojeniyi and Tewe, 2001; Antia *et al.*, 2006). This will enhance the performance of calcium in the development of bones and teeth. In addition, it has been reported to have been helpful in the formation of blood, intra cellular and extra cellular fluids within and outside the cells of the tissues (Mahan and Stump, 2004).

Antinutrient content of sweet potato samples are presented in Table 3. Phytate and Tannin contents of the two samples are low (SPLS; 1.07 and 0.22/100g;SPYP; 0.93 and 0.56/100g respectively for Phytate and Tannin). Oxalate contents is however high in the two samples (167.16 and 171.93 mg/100g for SPLS and SPYP respectively). In addition, it must be mention that quite a number of antinutrients exist in sweet potato. The low level of phytate and tannins are likely due to the processing and cooking methods the foods were exposed to. This assertion is in agreement with Eka (1977), Libert and Fran Ceschi (1987) and Leiner and Kakade (1980). However, it has reported (Pamplona-Roger, 2006), that phytate in foods have beneficial effects to the body as it contains antioxidants, a type of phytochemical that helps to eliminate free radicals from the body system and at the same time prevents and heal the body system from dangerous diseases. The oxalate contents though relatively high, has been reported to pose no antinutritional consequence as it is water soluble and leaches out during cooking (Munro and Bassir, 1969; Halloway *et al.*, 1989; Libert and Fran Ceschi, 1987).

Conclusion: The study revealed that sweet potato samples contained nutritional components, which if freely available for consumption will improve the nutritional status of the consumers and in effects reduce their nutritional problems. Moreover the appreciable protein and crude fibre in the sweet potato leaf sample gives it an added value for its consumption to be encouraged.

In addition, the study also revealed that carbohydrate constitutes the highest nutrient in the tuber and as such if sweet potato is freely available for consumption, it will reduce the rate of energy malnutrition in the society. The high carbohydrate in the SPYP sample favors better production of energy in meeting up with the daily activities of the day.

It also can be deduced that most nutrient present in all the sweet potato samples will be freely utilized by the body system. This is as a result of the low level of antinutrient which is of no nutritional consequence to the body system. So for sweet potato to contribute it quota in reducing malnutrition in the society, increased production, availability and consumption should be encouraged by the appropriate stake holders.

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