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Chemical composition of sweet potato (*Ipomea batatas Lam*) dishes as consumed in Kwara state, Nigeria

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Abstract: The nutrient and anti nutrient composition of some standardized sweet potato dishes in Kwara state was determined using official methods of analysis. The indigenous sweet potato dishes analysed included pounded sweet potato/yam; sweet potato leaf soup; boiled sweet potato; fried sweet potatoes and sweet potato/ beans pottage. There were significant differences ($p < 0.05$) for moisture content which in the proximate, minerals and antinutrient contents of sweet potato dishes. The moisture contents varied between 35.15% in sweet potato and pounded yam to 70.54% in sweet potato leaf soup. The highest protein content of 12.21% was found in sweet potato leaf soup and least value of 1.42% in sweet potato and pounded yam. The fat content of the samples ranged from 0.30% in sweet potato boiled to 3.88% in sweet potato leaf soup. Sweet potato boiled sample had the highest carbohydrate content of 70.54% while sweet potato leaf soup sample had the least value of 25.74%. The ash contents varied from 1.13% in sweet potato boiled to 8.83% in sweet potato leaf soup. The sweet potato leaf sample had the highest content of iron 8.82 ± 0.05 mg/100g while boiled sweet potato sample was highest in zinc (0.26 ± 0.01mg/100g) among all the dishes. Phytate contents ranged from 0.57 to 1.07 mg/100g, oxalate contents ranged from 126.93 to 178.27mg/100g and tannin ranged from 0.22 to 0.86 mg/100g for sweet potato dishes. The contributions of these varied nutrient contents to reducing the nutritional problems in the society were discussed.

Key words: Sweet potato, dishes, proximate, mineral, anti nutrient

Introduction

Nigeria is witnessing an increase in population growth; National Population Commission (NPC, 2006) estimated it to be 140,003,542. The high population without an equivalent increase in food production and availability to the citizens resulted to household food insecurity. This is an issue posing serious nutritional problem in Nigeria, particularly among children and mothers of child bearing age. The resultant effect is rampant malnutrition, affecting growth and development of the children and low productivity level among the mothers (Wardlaw and Kessel, 2002). This view is also confirmed by Maziya-Dixon *et al.* (2003) who stated that mal-nutrition is prevalent in Nigeria with about 76% children malnourished. The survey further revealed that 42% of children are stunted, 25% underweight and 9% wasted. The author further revealed that 16.4% of the women malnourished were from dry savannah, 9.9% moist savannah and 9% from humid forest. Among the factors affecting in adequate food suffered by the citizens is low socio-economic level of the people which is serious problem. The above problems prompted the campaign for increase production, utilization and consumption of traditional foods (sweet potato) among the citizens (FAO, 1986). The ideal of sweet potato came to mind been a traditional tuber crop adaptable to wide ecological range, relatively short growing season and of high yield potential even on infertile soil (Hahn, 1984). The tuber crop also came to mind because of it nutrient composition which helps to elevate the nutritional problems midst us.

To achieve the expected success in the campaign, for sweet potato, nutritional composition of the tuber crop must be known by the people. Thus, the paper is trying to bring to limelight and its role in attaining sound nutritional status. Previous literatures revealed the nutritive value of sweet potato (O'hair, 1984; Scott and Maldona, 1999; Ojeniyi and Tewe 2001). All agreed to the high content of carbohydrate in sweet potato tubers and as a good source of energy. Thus, if freely available for the consumption, sweetpotato will contribute its quota at reducing undernutrition in Nigeria. In addition Hiroshi *et al*.(2000); Ifon

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and Bassir (1979) revealed the value of sweet potato leaf as containing protein and crude fibre which are important for addressing deficiency diseases and colon diseases. The authors further revealed that both sweet potato tuber and leaf contain micro nutrients necessary for healthy body. Sweet potato tuber and leaf also contain antinutrients, such as phytate, oxalate and tannin (Fleming 1981; Udoessien and Ifon, 1990; Osagie 1998). These antinutrients could affect the digestion and availability of the nutrients in the body. But if sweet potato is exposed to processing and cooking, it reduces the level of antinutrient content and renders it of no nutritional consequence 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 obtained from the recipes collected from the people. The prepared dishes are sweet potato leaf soup, sweet potato and yam pounded sweet potato and beans mashed, sweet potato porridge, sweet potato boiled and sweet potato fried. All samples were oven dried at 65^{o} C and after grinding into powder mechanically ready for analysis.

Proximate analysis

The moisture contents, protein, fat, ash, crude fibre and carbohydrate were determined using standard methods of Association of Official Analytical chemist (2000).

Mineral elements analysis

Iron, zinc and calcium were determined using atomic absorption spectrophotometer (AOAC 2000, Model 200, Germany).

Antinutrient analysis

Phytic acid was determined by a combination of two methods, the extraction and precipitation of phytic acid were performed according to the methods of Wheeler and Ferrel (1971). Iron in the precipitate was measured according to the methods of Makower (1970). Tannin was determined spectrophotometrically by the acidified vanillin method (Burns, 1971) as modified by Chang *et al*. (1994). Oxalate was determined by using the standard method of Association of Official Analytical Chemist (2000).

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

The proximate compositions of the six sweet potato samples were as 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 to that of the tuber samples however carbohydrate content of the tuber samples was higher than that of the sweet potato leaf soup. The highest value for moisture contents was 70.54%, in sweet potato leaf soup followed by 60.54% in sweet potato porridge. Protein was highest in sweet potato leaf soup with 12.21% and least in sweet potato: yam pounded (1.42g/%). The ash contents were low in all the samples except sweet potato leaf soup and values ranged from1.13 to 8.83g/% (Table 1). The crude fibre contents of the samples were generally low in the tuber samples but high in the leaf sample. The values ranged from 0.67% to 5.88% in sweet potato leaf soup. The carbohydrate contents in the samples were generally high except for sweet potato leaf soup. The highest values was in sweet potato boiled (70.54g/%).

Table 2 gave the idea of the mineral elements present in sweet potato samples as consumed. The iron contents in all the samples were generally low apart from the sweetpotato leaf soup (8.82mg/100g). The zinc content of all the samples were ranged from 0.09to 27.99 mg/100g in sweet potato leaf soup. The calcium content was high in all samples.

Antinutrient content of sweet potato samples were as presented in table 3. Phytate revealed a generally low level and values ranged from0.57 in sweet potato porridge to 1.07mg/100g in sweet potato leaf soup. The Oxalate values were high in all the samples, ranging from 148.28mg/100g in sweet potato fried to 178.27mg/100g sweet potato porridge. Tannin values ranged from 0.22 mg/100g in sweet potato leaf soup to 0.86mg/100g in sweet potato: beans dish.

Discussion

The results of the proximate analysis have revealed that sweet potato samples were generally low in protein contents except leaf soup. This is not a surprised as the soup is a mixture of sweet potato leaf

Table 1. Proximate composition of sweet potato samples

Food sample	Moisture%	Protein%	Fat%	Ash%	Crude Fibre%	Carbohydrate %
Sweet potato leaf soup	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^{e}
Sweet potato and yam pounded	35.15±1.19^{f}	1.42±0.03^{g}	0.52±0.01^{e}	1.49±0.06d^{e}	0.67±0.00^{f}	68.37±1.50^{ab}
Sweet potato and Beans mashed	45.60±0.05^{e}	3.87±0.11^{d}	0.82±0.05^{d}	2.44±0.35^{b}	0.99d±0.02^{e}	58.27±0.72^{c}
Sweet potato porridge	60.54±1.57^{c}	2.66±0.01^{e}	0.51±0.02^{ef}	1.95±0.06^{bcd}	1.09±0.02^{d}	60.77±0.33^{c}
Sweet potato boiled	54.83±0.29^{d}	2.27±0.02^{f}	0.30±0.02^{fg}	1.13±0.10^{e}	0.84±0.06^{ef}	70.54±0.55^{a}
Sweet potato fried	39.16±0.18^{f}	2.25±0.08^{f}	2.65±0.11^{b}	1.84±0.05^{cd}	0.78±0.11^{f}	68.78±0.01^{ab}

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

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

Food sample	Iron (Fe) (mg/100g)	Zinc(Zn) (mg/100g)	Calcium(Ca) (mg/100g)
Sweet potato leaf soup	8.82±0.05^{a}	0.09±0.02^{f}	27.99±0.56^{c}
Sweet potato and yam pounded	1.61±0.05^{d}	0.12±0.00^{ef}	20.33±0.79^{e}
Sweet potato and Beans mashed	2.04±0.02^{c}	0.17±0.01^{de}	19.99±0.12^{f}
Sweet potato porridge	1.99±0.13^{c}	0.22±0.01^{cd}	24.55±2.01^{cd}
Sweet potato boiled	1.15±0.04^{e}	0.26±0.01 ^{c}	26.73±0.40^{cd}
Sweet potato fried	1.490.05^{d}	0.25±0.02^{c}	23.80±0.46^{d}

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
Sweet potato leaf soup	1.07±0.04^{c}	167.16±1.19^{d}	0.22±0.02^{f}
Sweet potato and yam pounded	0.93±0.01^{d}	171.93±4.81^{d}	0.56±0.01^{cd}
Sweet potato and Beans mashed	0.76±0.05^{def}	126.93±5.28^{f}	0.86±0.01^{bc}
Sweet potato porridge	0.57±0.02^{f}	178.27±0.29^{d}	0.63±0.01^{-b}
Sweet potato boiled	0.88±0.02^{de}	167.15±1.28^{d}	0.68±0.01^{bcd}
Sweet potato fried	0.72±0.05^{ef}	148.28±0.84^{e}	0.33±0.01^{d}

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

and other ingredients such as dry fish that can boost the protein content. It is desirable that plant foods should be consumed along with animal foods to enhance the nutritive value and reduce the malnutrition of the vulnerable group. Half of the samples studied have a low moisture content, which reduces the microbial load and enhance long shelf life (Temple *et al*., 1996). The present study revealed a low fat content in all the tuber samples which is in agreement with the work of Velmurugu *et al*. (1995).

However the fat in the leaf sample is in line with values reported by Hiroshi *et al*. (2000), Ojeniyi and Tewe (2001), Antia *et al.* (2006). The authors also observed that most plant tubers and leaves contain low level of fat, but its consumption should be encouraged since it s a type of fat that is easily used by the body system.

The crude fibre content of sweet potato tuber samples in this study was generally low and in agreement with 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 study also revealed that carbohydrate constitutes the highest nutrient in the tuber and in line with previous reports (O'hair, 1984; Velmurugu *et al*., 1995). These authors agreed that if sweet potato is freely available for consumption, it will reduce the rate of energy malnutrition in the society.

The mineral analysis revealed a low level of the elements, not withstanding iron which was higher in the leaf sample although the bioavailability was not tested. Nevertheless it should be noted that many Nigerian depends on plant sources for minerals and Vitamins. In line with this many authors (Bjorn *et al*., 1974; Hallberg *et al*., 1979) stated that about 90% of iron taken as foods in developing countries is non-heme. Majority of Nigerians consume more of plant foods because of their economic level. Litter and River (2003) further stated that the absorption rate of non- heme iron can be enhanced with intake of vitamin C foods. Although zinc in these present study is low in the samples but its consumption should be encouraged because of its benefits to the body system. Mahan and Stump (2004) supported this by stating the diverse roles of zinc in the metabolic pathway of the system. Calcium element in this study had the highest value and in line with the work of previous authors (Ojeniyi and Tewe 2001; Antia *et al*., 2006). Thus, if available to the body will enhance the performance of calcium in the development of bones and teeth. In addition, it helps in the formation of blood, intra cellular and extra cellular fluids within and outside the cells of the tissues (Mahan and Stump, 2004).

In addition, it must be mentioned that quite a number of antinutrients exist in sweet potato. Such antinutrients determined in this work include phytate, oxalate and tannin. The result revealed a low level of phytate and tannins because of the processing and cooking methods the foods were exposed to. This finding is in agreement with Eka (1977), Libert and Franceschi (1987) and Leiner and Kakade (1980). Nevertheless, Pamplona-Roger (2006), revealed a different thing about phytate in foods having beneficial effects to the body as it contains antioxidants, a type of phytochemical that helps to eliminate free radicals from the body system. Whereas the oxalate contents that is a bit high poses no nutritional consequence because according to Munro and Bassir (1969), Halloway *et al.* (1989), Libert and Franceschi (1987), it is water soluble which leaches out during cooking and removed by discarding the water.

Conclusion

The present study revealed that sweet potato dishes 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 high carbohydrate in the tuber samples favors better production of energy in meeting up with the daily activities of the day hence can be good source of calorie for vulnerable groups that need high energy density food because of small stomach, such as children and the elderly. Sweet potato can be used to reduce malnutrition in the society consequently increased production, availability and consumption should be encouraged by the appropriate stake holders.

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