



Nutritional Assessment of Hausa Potato *Solenostemon rotundifolius* (Poir)

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Abstract

The Hausa potato (*Solenostemon rotundifolius* (Poir)) is a tropical, multipurpose, minor tuber crop. This study was designed to carry out proximate composition and determination of some elements in Hausa potato. The moisture, ash, crude lipid, crude protein and crude fiber contents of both uncooked and cooked Hausa potato samples were determined according to the standard method. The elemental composition was determined using the Unicam Solar Atomic Absorption Spectrophotometer. The results showed that the samples were high in carbohydrate but low in lipid contents. Although Hausa potato was significantly higher in moisture, carbohydrate and crude protein contents were not significantly different ($P < 0.05$) in both samples. Whereas boiling improved the availability of carbohydrate and fiber, boiling also reduced the ash content, protein composition and fat in the tuber sample. Cooking significantly lowers the calcium, potassium, phosphorus, sodium and magnesium contents in the sample. Cooking remarkably reduced the anti-nutrient contents of Hausa potato. It is recommended that further studies should be carried out to determine other nutritional composition of various branches such as volatile oils, sesquiterpenes and diterpenes compositions and antimicrobial activities.

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Introduction

Nutrition is a fundamental pillar of human life, health and development across the entire life span. From the earliest stages of fetal development, at birth, through infancy, childhood, adolescence, and on into adulthood and old age, proper food and good nutrition are essential for survival, physical growth, mental development, performance and productivity, health and well-being. It is an essential foundation of human and national development (Popkin B.M *et al.*, 2012) [11]. Hunger and malnutrition remain among the most devastating problems facing the majority of the world's poor and needy, and continue to dominate the health of the world's poorest nations. Nearly 30% of humanity infants, children, adolescents, adults and older persons in the developing world are currently suffering from one or more of the multiple forms of malnutrition. This remains a continuing travesty of the recognized fundamental human right to adequate food and nutrition, and freedom from hunger and malnutrition, particularly in a world that has both the resources and knowledge to end this catastrophe (De Onis M *et al.*, 1998) [2]. The contribution of roots and tubers to the energy supply in different populations varies with the count. The relative importance of these crops is evident through their annual global production which is approximately 836 million tonnes (FAOSTAT 2013) [4]. Asia is the main producer followed by Africa, Europe, and America. Asian and African regions produced 43 and 33%, respectively, of the global production of roots and tubers (FAOSTAT 2013) [4]. A number of species and varieties are consumed but cassava, potatoes, and sweet potatoes consist of 90% global production of root and tuber crops (FAOSTAT 2013) [4].

The Hausa potato *Solenostemon rotundifolius* (Poir) is a tropical, multipurpose, minor tuber crop. It has been reported to be one of the best staple tuber crops in terms of its distinctive fragrance, peculiar taste, medicinal, nutritional and economic values. It is cultivated in the West African countries of Ghana and Nigeria (Nanema RK, Traore ER, *et al.*, 2009) [7].

Currently, its genetic resources are disappearing into extinction due to undesirable features such as small tuber size Nigeria (Nanema RK, Traore ER, *et al.*, 2009) [7], branching of the tubers, lack of balance between the source potential and sink capacity which results in low tuber yield as well as the intense labour required in its production. Consequently, it is being replaced by more popular root and tuber crops like the Irish potato, sweet potato, cassava and yam.

The plant is a small herbaceous, dicotyledonous annual, 15-30 cm high, prostrate or ascending, with a succulent stem and thick leaves. It has an aromatic mint-like smell. Flowers are small and may be white, blue, pink or pale-violet in colour; they are produced on an elongated terminal with distal inflorescence and slender false spikes (Steenft M 2009) [12]. It has small dark-brown edible tubers produced at the base of the stem.

The Hausa potato has the potential of increasing the food bank, solving malnutrition problems, improving food security and increasing yield per unit area of land because of its higher biological efficiency and adaptation to different environments. It also has the potential and prospects for enlarged adoption into other agro-ecological zones in Nigeria and thereby contributing to food security, diversification of the local food base and sustaining livelihood. However, farmers growing this crop follow indigenous methods which result in relatively low yield because of lack of high-yielding varieties and poor agronomic practices. Consequently, the cultivation of the Hausa potato has declined considerably, and this has affected its importance as a starchy vegetable and a staple crop. It has almost disappeared from areas where it was hitherto widely cultivated (Nkansah GO 2004) [8]. The yield

Determination of Total Phosphorus

Total phosphorus was obtained using the ascorbic acid blue color procedure of Okalebo *et al.* (2002) [9] by reading the absorbance at a wavelength of 880 nm on a Helios Gamma spectrophotometer (Helios Gamma UV-Vis Spectrophotometer, Thermo Spectronic, Cambridge, U.K.).

Determination of Calcium Oxalate Content

The calcium oxalate content was determined using the method of Ukpabi and Ejidoh (1989) can be increased by adopting improved production technologies and cultivars (Akinpelu AO, Olojede AO, *et al.*, 2011) [1].

Materials and Methods

Materials

Sample Material

The sample materials used Hausa potato (Tumuku) was procured from Hong market Adamawa State Nigeria

Reagents/Chemicals

Ascorbic acid, concentrated H₂SO₄, a catalyst (selenium), salicylic acid and hydrogen peroxide.

Equipment

Fritsch pulverisette Rotor-Speed mill (Fritsch GMBH, Laborgeraetebau, Germany), refrigerator, Unicam Solar Atomic Absorption Spectrophotometer (model 969MkII, Unicam Ltd., Cambridge, UK), Helios Gamma spectrophotometer (Helios Gamma UV-Vis Spectrophotometer, Thermo Spectronic, Cambridge, U.K.), Oven (New life DHG-9023A), Apparatus (Quickfit),

Kjeldahl Flask, Volumetric flask, Conical flask Beakers, Pipette, Crucible, Titration Apparatus, Filtration Apparatus, Sample bottles (glass and plastics).

Methods

Sample Preparation

The tubers were hand peeled with a kitchen knife, washed in distilled water, sliced with a knife into thin pieces of about 2 mm thick and air-dried on trays for 20 min. The sample was separated into two equal portions (400 g each). A portion of the sample was separately cooked by boiling in about 3.5 L of distilled water for 20 min and later air-dried as before. Both the cooked and uncooked portions of the sample were further dried in an oven at 60°C to constant weights. The dried samples were separately milled using a Fritsch pulverisette Rotor-Speed mill (Fritsch GMBH, Laborgeraetebau, Germany) and kept in well-labeled air-tight containers and later stored in the refrigerator for analyses

Chemical Analyses

The moisture, ash, crude lipid and crude fiber contents of Hausa potato samples were determined according to the standard method of the Association of Official Analytical Chemists (AOAC 2000).

Determination of Crude Protein

Crude protein was determined by the micro-Kjeldahl method (Okalebo *et al.* 2002) [9].

Determination of Carbohydrate Content

The percent carbohydrate was determined by subtracting the known amounts of moisture, crude fibre, crude protein, crude fat, and total ash from 100. The difference will be reported as the percent carbohydrate i.e.

Available carbohydrate = 100- (% moisture + % ash + % protein + % fiber + % fat). AOAC (2000)

A mixture of concentrated H₂SO₄, a catalyst (selenium), salicylic acid and hydrogen peroxide were used for sample digestion, and subsequently, phosphorus, calcium, sodium, Potassium and magnesium in the digests will be determined.

Determination of Element Composition

The mineral element composition was determined using the Unicam Solar Atomic Absorption Spectrophotometer (model 969MkII, Unicam Ltd. Cambridge, UK). Potassium, sodium, magnesium and calcium contents will be determined by reading their absorbance at 766.5, 589.0, 285.2 and 422.7 nm wavelengths, respectively.

Determination of Tannins and Phytate

Tannins was determined by the method of Makkar *et al.* (1993), whereas phytate was determined using the method of Wheeler and Ferrel (1971). The phytate content was calculated using a 4:1 iron-to-phytate molecular ratio.

Statistical Analysis

All determinations were replicated twice. A completely randomized two-way factorial experiment was used. The data obtained were subjected to analysis of variance using SAS (SAS Institute Inc. 1999) package. The main factors to test is the Hausa potato (at two levels: cooked and uncooked). The means were separated using the Duncan multiple range test (SAS 1999).

Results and Discussion

Table 1. Proximate composition of Hausa Potato (*Solenostemon rotundifolius*) uncooked and cooked

Parameter	Uncooked (Mean±SD)	Cooked (Mean±SD)
Moisture (%)	72.20±0.000 ^b	60.15±0.000 ^a
Protein (%)	3.12±0.014 ^b	2.75±0.000 ^a
Fat (%)	0.22±0.000 ^b	0.16±0.014 ^a
Fibre (%)	3.00±0.000 ^a	3.56±0.014 ^b
Ash (%)	1.50±0.000 ^b	1.15±0.000 ^a
Carbohydrate (%)	19.96±0.014 ^a	32.23±0.028 ^b

Data are presented as mean ±SD, N = 2; Values with different superscript across the row shows significant difference (p< 0.05)

Proximate Composition

The results of the proximate composition of Hausa potato (uncooked and cooked) are presented in Table 1. The values obtained were 3.12±0.014^b and 2.75±0.000^a % as protein contents of uncooked and cooked sample respectively, these values show a close relationship reported by Opaleye *et al.*, 2018^[10]. The level of protein in these indicates that they can contribute to the daily protein requirements for humans which are based at 23-56 g as stipulated by NRC.

The crude fat contents of 0.22±0.000^b and 0.16±0.014^a % were recorded for uncooked and cooked respectively which have Similar values reported by Opaleye *et al.*, 2018^[10].

The respective values of 3.00±0.000^a and 3.56±0.014^b % were obtained as the crude fibre contents of uncooked and cooked. These values were higher than 1.1± 0.000% for uncooked sample reported by Enyiwu, *et al.*, 2014. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body. A low fibre diet has been associated with heart diseases, cancer of the colon and rectum, varicose veins, phlebitis, obesity, appendicitis, diabetes and constipation. (Mohaammed *et al.*,

2014).

The ash contents of the uncooked and cooked samples are 1.50±0.000^b and 1.15±0.000^a respectively. This is similar to the values reported by Opaleye *et al.*, 2018^[10]. The proportion of ash content is a reflection of the mineral contents present in the food materials. (Mohaammed *et al.*, 2014).

The moisture content was 72.20±0.000^b and 60.15±0.000^a % for uncooked and cooked respectively. Similar values were reported by Opaleye *et al.*, 2018^[10]. The moisture content of any food is an index of its water activity and it is used as a measure of stability and susceptibility to microbial contamination. (Mohaammed *et al.*, 2014).

The values of 19.96±0.014^a and 32.23±0.028^b % were obtained as carbohydrate contents of uncooked and cooked respectively which were higher compared with the value of 21.0± 0.000 reported by Enyiwu, *et al.*, 2014. The carbohydrate content obtained from these samples can be used to rank Hausa potato as carbohydrate – rich tuber due to relatively high carbohydrate content of crop make it is a good quality food.

Mineral Composition

Table 2 Mineral Composition of Hausa potato (*Solenostemon rotundifolius*) uncooked and cooked (mg/100g)

Processing Method	Calcium (Ca)	Potassium (K)	Phosphorus (P)	Sodium (Na)	Magnesium (Mg)
Uncooked	314.40±0.212 ^b	251.32±0.007 ^b	47.26±0.014 ^b	22.33±0.007 ^b	16.18±0.007 ^b
Cooked	275.16±0.007 ^a	215.37±0.014 ^a	35.17±0.007 ^a	14.76±0.014 ^a	15.85±0.007 ^a

Data are presented as mean±SD, N = 3; Values with different superscript down the column shows significant difference (p< 0.05).

Mineral Composition

The mineral compositions of these samples are presented in Table 2. The results indicate that calcium is the most abundant mineral in the two samples, with mean values ranging from 314.40±0.212^a mg/100 g and 275.16±0.007^b mg/100 g for uncooked and cooked sample respectively. The mineral contents of the uncooked and the cooked Hausa potato are Ca (314.40 and 275.16 mg/100), K (251.32±0.007^a and 215.37±0.014^b mg/100 g), P (47.26±0.014^a and 35.17±0.007^b mg/100 g), Na (22.33±0.007^a and 14.76±0.014^b

mg/ 100 g) and Mg (16.18±0.007^a and 15.85±0.007^b mg/100 g). The results of this study revealed that uncooked and cooked sample contain significant amount of mineral nutrients such as Ca, K, P, Na and Mg, whose salts regulate the acid–base balance of the body. Consumption of such micronutrient-rich foods helps in building a strong immune system, thereby helping the body to absorb, utilize and digest nutrients. Generally, cooking significantly reduced the mineral contents in the sample (Lewu M.N *et al.*, 2010)^[5].

Anti-nutrient Composition

Table 3: Anti-nutrient Composition of Hausa potato (*Solenostemon rotundifolius*) uncooked and cooked

Processing Method	Oxalates (mg/100 g)	Phytates (mg/100 g)	Tannins (mg/100 g)
Uncooked	3.16±0.01 ^b	6.23±0.01 ^b	2.56±0.01 ^b
Cooked	0.66±0.01 ^a	3.12±0.00 ^a	1.06±0.00 ^a

Data are presented as mean±SD, N = 3; Values with different superscript down the column shows significant difference (p< 0.05).

Anti-Nutrient Composition

The results of anti-nutrient analyses indicated that oxalate and phytate contents were significantly higher (6.23 ± 0.01^b and 3.12 ± 0.00^a mg/100 g) in uncooked sample when compared with the cooked sample (3.16 ± 0.01^b and 0.66 ± 0.01^a mg/100 g). Cooking significantly reduced the levels of the anti-nutrients. The mean values for calcium oxalate reduced by about 50% after boiling in water for 20 min. This is an indication that oxalate has a hydrothermal ability, which may be due to the dual effect of leaching and thermal degradation. This is beneficial because oxalic acid and its salts can have deleterious effects on human nutrition and health, particularly by decreasing calcium absorption and aiding the formation of kidney stones (Lewu M.N *et al.*, 2010) [5]. Tannin content was significantly higher ($p < 0.05$) in uncooked sample when compared to the cooked sample. Tannins affect the nutritive value of food products by forming a complex with protein, thereby inhibiting digestion and absorption. The reduction in the tannin contents indicates that boiling could decrease the tannic acid in root and tuber crops. Phytate is widespread in roots and tubers (Lewu M.N *et al.*, 2010) [5]. This is a well-known anti-nutrient of plant food. It decreases the bioavailability of nutritionally significant mineral elements. Like oxalates, phytate can bind essential minerals to form insoluble or indigestible complexes, thereby preventing their absorption (Lewu M.N *et al.*, 2010) [5]. In many cases, phytic acid content may vary depending on the crop variety, climatic conditions, location, irrigation conditions, type of soil and the growing season of the plant (Lewu M.N *et al.*, 2010) [5].

Conclusion

The study provides evidence that the crop has a nutritional potential. Thus, Hausa potato consumption should be encouraged and popularized as an additional tuber crop to the people of Hong Local Government Area of Adamawa State.

Consent

It is not applicable.

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Competing Interests

Authors have declared that no competing interests exist.

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