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Full Length Research Paper

Soil properties, nutrient and anti-nutrient properties of two medicinal vegetables growing in two popular dump sites in Akwa Ibom State, Nigeria

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The proximate nutrient composition and anti-nutrient compositions of two medicinal vegetables; *Ipomoea batatas* (L.) Lam. And *Laportea ovalifolia* (Schumach) Chew. were studied at two dump sites within Uyo metropolis. The results revealed that the proximate nutrient composition of the two medicinal vegetable leaves had moisture contents ranging between (64.62 – 96.22%) in *I. batatas* and (65.63 – 71.36%) in *L. ovalifolia*; dry matter content ranging between (35.38 – 23.78%) in *I. batatas* and (34.70 – 28.40%) in *L. ovalifolia*; crude protein ranging between (21.44 – 21.81%) in *I. batatas* and (14.00 – 15.31%) in *L. ovalifolia*; ether extracts ranged between (7.87 – 6.50%) in *I. batatas* and in *L. ovalifolia* (7.09 – 7.20%). Crude fibre contents in *I. batatas* ranged between (4.36 – 3.86%) and in *L. ovalifolia*, (3.33 – 3.46%); ash contents ranged between (6.55 – 5.80%) in *I. batatas* and (5.00 – 5.80%) in *L. ovalifolia;* carbohydrate content in the leaves of *I. batatas* were between (59.77 – 61. 95%) and (70.58 – 68. 82%) in *L. ovalifolia*. The proximate anti-nutrient composition revealed that; oxalate were present in moderate amounts ranging from (61.60 – 79.20mg/100g) in *I. batatas,* but abundant in *L. ovalifolia* (70.40 – 79.20mg/100g); cyanide occurred in very low amounts (10.74 – 12.02mg/100g) in *I. batatas* and in *L. ovalifolia* (0.830-13.06mg/100g); tannins were present in moderate amounts in both *I. batatas* (45.13 – 65.41mg/100g) and *L. ovalifolia* (38.13 – 77.90mg/100g); phytate also occurred in moderate amounts in *I. batatas* (58.07 – 86.22mg/100g), but was abundant in *L. ovalifolia* (82.05 – 93.07mg/100g). The physicochemical analysis of the soil samples of the two dump sites revealed that the soils were slightly acidic (in dump site one) and neutral (in dump site two). Students t-test was used to compare the means of the two medicinal vegetables in the dump sites and it revealed significant differences at ($p>0.05$).

Keywords: *Ipomoea batatas* , *Laportea ovalifolia*, nutrient, anti-nutrient

INTRODUCTION

Plants have provided man with all his needs in terms of shelter, clothing, food, flavours and fragrances (Essiett *et al*., 2011). The genus *Laportea* Guad is an element of the family urticaceae which is composed of 22 species? It is a predominant old world genus, two species have been reported for Southern Nigeria (Essiett *et al*., 2011) namely *Laportea aestuans* (Linn). Chew and *Laportea ovalifolia* (Schumach).

Leaves of *Laportea ovalifolia* are eaten cooked as a vegetable in Cameroon, Dr. Congo, Kenya and Tanzania.

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In Tanzania, chopped and boiled young leaves are often mixed with beans or peas and served with a staple food (Ruffo *et al*., 2002). Although they have a mild taste, they are eaten in small amounts. Also, an infusion prepared by pounding and soaking leaves in water is taken to help deliver the placenta after childbirth, and a decoction made by boiling roots in water is taken to prevent excessive menstrual bleeding (Soforawa, 1993). In Gabon, cooked leaves are eaten as a remedy for stomach ache and when cooked with peanuts are given to pregnant women (Etukudo, 2003). It is also used during initiation rituals. In Cameroon, the fresh leaves are used as a diuretic, as a cure for blenorrhoea and chest problems and in fish poisons (Hughes, 2006).

Laportea ovalifolia is of economic importance in Nigeria, the leaves are used as a haemostatic on acts and wounds as an anti-irritant, whereas the fruits are used as a poison antidote (Bouch *et al*., 2004; Essiett *et al*., 2011). Leaves, roots and the whole plants are used to cure internal ulcers, diabetes bronchitis and filariasis (Forcho *et al*., 2009). When the leaves decoction are mixed with the leaves commonly called Mmeme (*Justicia schimperi*), Ndoroenyong (*Viscum album*) and also Iko (*Lagenaria siceraria*), the leaves are cut, dried and all mixed, boiled and when allowed to cool and administered twice a day after a meal, it can cure stroke, rheumatism, swelling and diabetes (Fabricant *et al*., 2001; Essiett *et al*., 2011). The people of Ibibio tribe in Nigeria use the leaves and tender shoots of the plant as pot herb or vegetables in soups. Some household use the plant as vegetables when preparing food for babies (Etukudo, 2003)

Ipomoea batatas

Ipomoea batatas commonly known as "Sweet potato" is a dictyledonous plant belonging to the family convolvulaceae. Its large, starchy sweet-tasting tuberous roots are an important root vegetable (FAO, 1992). The young leaves and shoots are sometimes eaten as greens. Of the approximately 50 genera and more than 1,000 species of Convolvulaceae, *Ipomoea batatas* is the only crop of major importance, some others are used locally but many are actually poisonous.

Ipomoea batatas is an underground tuberous root (Gad *et al*., 2009), the plant is an herbaceous perennial vine bearing, simple, entire, and alternate heart-shaped or palmately lobed leaves (Gad *et al*., 2009).

Although the leaves and shoots are also edible, the starchy tuberous roots are by far the most important product. In some tropical areas, they are a staple food crop. The young leaves and vine tips of sweet potato leaves are widely consumed as a vegetable in West African countries (Guinea, Sierra leone and Liberia), as well as in Northeastern Uganda, East Africa. (Abidin, 2004). The tops are also used in the manufacture of alcohol, vinegar, lactie acid, yeast and acetone. Young sweet potato leaves are also used as baby food particularly in Southeast Asia and East Asia (Ma *et al*., 2003).

Sweet potato butter can be cooked into a gourmet spread, also often eaten with cheese. In South America, the juice of red sweet potatoes is combined with lime juice to make a dye for cloth. All parts of the plant are used for animal fodder (Berrin, 1997). Sweet potatoes are often found in moche ceramics. Potato starch is used in laundry and in the preparation of alcohol. The plant pacifies vitiated vata, pitta, burning sensations, constipation, general weakness, renal calculi, and sexual stimulant. Above ground parts can be used as mulch, and the plant serves very well as living mulch around and under fruit trees or any orchard (Scott *et al*., 2000).

The center of origin and domestication of sweet potato is Peru, South America. Sweet potatoes are now cultivated throughout tropical and warm temperate regions wherever there is sufficient water to support their growth. According to the Food and Agriculture Organization (FAO) statistics, World production in 2004 was 127 million tons (FAO, 1992). Sweet potato is an underground stem tuber extensively cultivated in India in the hills as well as in the plains. It is usually grown during the cold months, but can be grown both as a summer crop and a winter crop (Berrin, 1997). It is a universal item of food all over the World.

They are mostly propagated by stem or root cuttings or by adventitious roots called "slips" that grow out from the tuberous roots during storage. They grow well in many farming conditions and have few natural enemies, pesticides are rarely needed. Sweet potatoes are grown on a variety of soils, but well-drained, light – and medium – textured soils with a pH range of 4.5 – 7.0 are more favorable for the plant (Woolfe, 1992). They can be grown in poor soils with little fertilizer. Therefore this study is aimed at determining the nutrient and anti-nutrient constituents of two (2) vegetables growing in a popular dump site and mineral components of two (2) vegetables growing in a popular dump site and thus relates the nutrient and anti-nutrient composition of the two (2) vegetables with its mineral contents.

MATERIALS AND METHODS

Study area

This study was conducted in a popular dump site located at Udi Street, Uyo Local Government Area, Akwa Ibom State. Uyo is situated between latitude 5^{o}3'O'' North and longitude 7^{o}56' O'' East (Maplandia, 2005). Akwa Ibom State. Uyo is situated between latitudes 4^{o}32' and 5^{o}53' North and longitude between 7^{o}25' and 8^{o}25' East. It covers a total land area of 8,412km^2 (AKSG, 2008). The location of Akwa Ibom is just north of the equator and within the humid tropics and its proximity to the sea makes the state generally humid.

On the basis of its geographical location, the climate of Akwa Ibom State can be described as a tropical rainy area which experiences abundant rain fall with very high temperature. The mean annual temperature lies between 26^{o}c and 29^{o}c and average sunshine cumulated to 1,450 hours per year, while annual rain fall ranges from 2,000mm to 3,000mm, depending on the area. Naturally, maximum humidity is recorded in July while the minimum humidity occurs in January (AKSG, 2008). As with every Nigerian coastal area, the state experience two (2) main seasons, the wet and dry seasons.

Collection of plant samples

Fresh leaves of *Ipomoea batatas* and *Laportea ovalifolia* were obtained from a popular dump site located at Udi Street, Uyo local Government Area of Akwa Ibom State. The plants were identified and authenticated by Dr. (Mrs) M. E. Bassey, a taxonomist and Head of Department, Botany and Ecological studies, Faculty of science, University of Uyo, Uyo. Proximate composition analysis, nutrient and anti-nutrient evaluation and contents of the plant samples were then carried out.

Proximate composition (analysis)

The plant samples were brought to uniform size, and then analyzed for moisture content, crude protein, crude fibre, either extract, ash, dry matter and carbohydrate (Nitrogen free-extract

Determination of moisture content

Moisture content was determined by "oven-Drying method (Ibrahim *et al.,* 2010).

Determination of ash

Ash content of the leaves were determined by the method of James (1996).

2-5g finely ground, dried sample was accurately weighed into a crucible. The sample was charred on a heater inside a fame cupboard. The sample was transferred into a pre-heated muffle furnace at 550^{o}c for two hours until a light gray ash results

Determination of crude protein

Crude protein was determined by the kjeldahl method (James 1996).

Determination of crude fat

The fat content was extracted with petroleum either using "Souhlet Extraction method" (James, 1996).

Determination of crude fibre

To determine crude fibre content of the plant samples, 0.155g of the sample was weighed (W_o) and transferred into a one litre (1L) conical flask (Ibrahim *et al.,* 2010).

Determination of soluble carbohydrate (nitrogen free extract)

Nitrogen free extract referred to as soluble carbohydrate. This was not directly determined but obtained as a difference between crude protein and the sum of ash, protein, moisture, crude fat and fibre.

Anti-nutrient evaluation

Anti-nutrient are natural or synthetic compounds that interfere with the absorption of nutrients. Nutrition studies focus on those anti-nutrients commonly found in food sources (plants), such as calcium, Zinc, Iron and copper. Another particularly widespread form of anti-nutrients is the flavinoids which are a group of polyphenolic compounds that include tannins (Beecher, 2003).

Determination of oxalates

Oxalate was determined by titration method which involves three (3) major steps:

i) Digestion
ii) Oxalate precipitation
iii) Permanganate ($KmnO_4$), using the method of Mecance and Widdoisson (1953).

Determination of phytic acid (phytate)

Phytate was determined by Mecance and Widdoisson method (1953).

Determination of tannins

The Folin-Denis Spectrophotometric method was used, as described by Pearson (1976).

Table 1. Mean (±S.E) proximate nutrient composition of *Ipomoea batatas* and *Laportea ovalifolia* in 2 sites

	Site I		Site 2	
	I. batatas(IpS1)	***L. ovalifolia(LoS1)***	***I. batatas(IpS2)***	***L. Ovalifolia (LoS2***
Moisture content	64.62±0.01	65.63±0.00	76.22±0.21*	71.36±3.12
Dry matter	35.38±0.005*	34.70±0.20*	23.78±0.31	28.40±2.01
Crude protein	24.44±0.10*	14.00±0.00	21.88±0.00*	15.31±0.32
Ether Extract	7.90±0.00	7.09±0.91	6.51±0.00	7.20±0.00
Crude fibre	4.36±0.01	3.33±0.00	3.86±0.10	3.46±0.50
Ash	6.55±0.003	5.00±0.11	5.80±0.11	5.20±0.30
Carbohyderate	59.77±0.53	70.58±0.05*	61.95±0.05	68.83±6.20*

*Significance at 5% level.

Table 2. Mean (±S.E) proximate anti-nutrient composition of *Ipomoea batatas* and *Laportea ovalifolia*

	Site 1		Site 2	
	I. batatas	***L. ovalifolia***	***I. batatas***	***L. ovalifolia***
Cyanide	12.02±1.00	13.06±0.00	10.74±0.10	0.830±0.0002
Oxalate	79.20±0.00	88.00±0.32	61.60±0.31	70.40±0.10
Tannins	45.13±0.16	77.90±0.44	65.41±0.20	38.13±0.00
Phytate	86.62±0.00	93.07±0.05	58.07±0.00	82.05±0.10

Determination of Hydrogen Cyanide (HCN)

Hydrogen cyanide was determined by the “Alkaline Titration method.”

Determination of mineral elements composition

Wet masking method is one of the universally accepted techniques for isolating metals in plant samples from their complex matrix before evaluating them with atomic absorption spectrophotometer or flame photometer. This is achieved by heating the sample with a digestion mixture containing cone. Nitric, perchloric and sulphuric acids is a kjeldahl flask for some hours. All organic matter is oxidized to water and carbon dioxide while metal ions are left behind as uncomplexed ions, while not necessarily for oxidation. The presence of sulphuric acid ensures that samples do not dry out to an explosive per chlorate. After digestion the sample is diluted appropriately before being used for the actual determinations.

RESULTS

Table 1 shows the nutrient composition of *Ipomoea batatas* and *Laportea ovalifolia* harvested from two different locations (sites 1 and 2 respectively). The moisture content in the samples ranged between 64.6-76.22% in *Ipomoea batatas* and *Laportea ovalifolia* 65.63 to 71.36% in the two sites. The dry matter content was significantly ($p<0.05$) higher in vegetables found in site one (35.9-34.70%) but was low in site 2 vegetables. Crude protein was higher in *Ipomoea batatas* found in site 1 and 2 (21.44 and 21.88% respectively) and was lower in *Laportea ovalifolia* harvested from site 1 and 2 (14.00 and 15.31% respectively). Ether extracts and crude fibre were higher in site 1 *Ipomoea batatas* (8.2% and 4.6%). Ether extracts was least in site two *Ipomoea batatas* with a value of 6.51% while crude fibre was least in *Laportea ovalifolia* harvested from site 1 (3.33%). The ash content of this vegetable varied slightly with the two locations. The highest ash content was found in *I. batatas* harvested from site 1 (6.55%) but was least in followed by those from site 2 (5.6%) while site 1 *Laportea* samples had the least ash composition (5.00%). Carbohydrate was highest in site 1 laportea ovalifolia *reaching a mean value of 70.58% and least in site* 1 *I. batatas* (59.77%).

Table 2 shows the anti-nutrient composition of *Ipomoea batatas* and *Laportea ovalifolia* harvested from two different locations (sites 1 and 2 respectively). Generally, the result shows a high toxicant level in samples collected from site 1 while site 2 shows the least anti-nutrient composition. The oxalate content in the samples ranged between 88.0% in site one *Laportea ovalifolia* and 38.13% in site two *Laportea ovalifolia*. The highest phytate content was found in *Laportea ovalifolia* harvested from site 1 (93.0% while site two *Ipomoea batatas* had the least (58.35%). Hydrogen cyanide was highest in *Laportea ovalifolia* taken from site one (13.05%) and was least in site 2 *Laportea ovalifolia*

(0.83%). Tannins was higher in site one *Laportea ovalifolia* (77.90%) while site two *Laportea ovalifolia* had the least of 38.13% tannin content.

DISCUSSION

The results of proximate composition of *Ipomoea batatas* and *Laportea ovalifolia* leaves are represented in Table 1. The mean values for ash content in *Ipomoea batatas* from the two sites is 6.15% while that of *Laportea ovalifolia* is 5.1%. From this result, the ash content of this vegetables is lower than that of some leafy vegetables commonly consumed in Nigeria such as *Talinum triangulare* (20.05%). It is even lower than some other medicinal vegetables such as *Occimum graticimum* (8.00) and *Hibiscus esculentus* (8.00) (Akindahunsi and Salawu, 2005). The low ash content is a result therefore suggests a low deposit of mineral elements in the leaves. Ether extract had a mean value of 7.2% in *Ipomoea batatas* and 7.1% in *Laportea ovalifolia*. This shows that the crude fat is moderate when compared to those of *Talinum triangulare* (5.90%), Baseila alba (8.71), Amaranthus hybridus (4.80%), *Calchorus africanum* (Ifon and Basir, 1979; Akindahunsi and Salawu, 2005). Comparing this result with the values obtained from other leaves shows that *Laportea ovalifolia* and *Ipomoea batatas* leaves contain low fat contents. Dietary fats function in the increase of palatability of food by absorbing and retaining flavors. A diet providing 1-2% of its calorie of energy as fat is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular disorders such as atherosclerosis, cancer and aging. It has been reported that crude protein serves as enzymatic catalyst, mediate cell responses, control growth and cell differentiation (Whitney and Rolfes, 2005).

Laportea ovalifolia leaves with an average of 14.7% from the two sites contain moderate crude protein and *Ipomoea batatas* (21.6) contains high crude protein when compared to *Heinsia crinita* (14.7%) and *Amaranthus caudatus* (20.59) (Etuk *et al*., 1998, Akindahunsi and Salawu, 2005). *Ipomoea batatas* protein value compares favourably with the leaves of other plants like cassava (*Mlanihot utilisima*), *Piper guineeses* and *Talinum triangulare* with values of 24.88%, 29.78%, 31.00% respectively (Akindahunsi and Salawu, 2005). This low protein in *Laportea ovalifolia* is not unrelated with its high tannin content since high tannin content have been implicated in the inhibition of bioavailability of protein and minerals (Davidson *et al*., 1975).

The crude fibre content of 4.1% in *Ipomoea batatas* and 3.4% in *Laportea ovalifolia* is low when compared to Talinum triangulare (6.20%), Piper guineeses (6.40%), Corchorus olitorius (7.0%), bitter leaves (Vernonia amygdalina), 6.5% (Akindahunsi and Salawu, 2005), Non-starchy vegetables are the richest sources of dietary fibre (Agostoni *et al*., 1995) and are employed in the treatment of diseases such as obesity, diabetes, cancer and gastrointestinal disorders (Saldanha, 1995). Hence, the low fibre content of the plant suggest that these vegetables from site 2 having highest value (*Laportea*-71.36 and *Ipomoea*-76.22mg/100g). Showing that they are more prone to deterioration since foods with high moisture content are more prone to perishability (Fennema and Tannenbaum, 1996). Values of moisture for both *Ipomoea* leaves and *Laportea ovalifolia* leaves corroborated with standard references for sweet potato:82.21-87.48% (Antia *et al*., 2006; FAO, 2006b; Woolfe, 1992) and for *Laportea ovalifolia* (Essiett, *et al*., 2011).

The results for anti-nutrient composition (Table 2) revealed low values of cyanide ranging from 0.83 – 13.05mg/100g in *Laportea ovalifolia* (site 2 and site 1 respectively) and 10.74 – 12.20 mg/100g in *Ipomoea batatas*. But phytic acid, tannins and oxalate (78.6mg/100g), were high when compared to standard values obtained for *Vernonia amygadalina* (bitter leaf) and *Telfairia occidentalis* (fluted pumpkin) (McGraw Hill, 1987). This may constitute potent human poisons. Interestingly, cooking properly before consumption significantly reduces the total oxalate and other anti-nutrient content of leaves and vegetables (Akwaowo *et al*., 2000).

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