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EVALUATION OF ANTINUTRIENTS AND MINERAL COMPOSITION OF TRIFOLIATE YAM *(DIOSCOREA DUMENTORUM) AND WHITE COCOYAM (XANTHOSOMS ATROVIREN)*

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ABSTRACT

Anti nutrients and mineral compositions of the flour powder and flour and flour paste of tubers of trifoliate yam (Dioscorea dumentorum-Ona) were determined using standard methods. The results of the anti nutrients of deterimation Dioscorea dumentum showed that the phyate and cyanide contents (9.858 and 87.26mg/100g respectively) of the four powder were higher than that of the flour paste (5.8 and 74.76mg/100g respectively). While the oxalate, tannins and trypsin inhibitor contents were (18.16, 7.4 and 0.16mg/100g respectively). Values obtained for the anti-nutrients in Xanthosoma atroviren showed that the oxalate, tannins cyanide and trypsin inhibitor contents (16.38, 7.62, 89.23 and 0.18mg/ 100g respectively) of flour powder were higher than that of the four paste (12.53, 6.16 and 28.72mg/100g respectively). The results of the mineral composition analyzed showed that Dioscorea dumentorum has higher values of K, P, Fe, Zn and Mn (0.30, 0.93, 8.72, 12.08 and 5.01mg/100g respectively). There was no significant difference in the Ca, Mg, Na, Cu and Pb contents of both species. Hg was only in trace quantities in both plant species. However, the results indicated that the cyanide and phytate contents of Dioscorea dumentorum and Xanthosoma atroviren were reduced significantly by cooking. From the results, the flours of the two species of yam have adequate levels of minerals and tolerable levels of anti-nutrients and therefore can be exploited for industrial and nutritional purposes.

Keywords: *Anti-nutrient, Mineral, Dioscorea dumentorum, Xanthosoms atroviren*

INTRODUCTION

Anti-nutritional factors are those substances found in most food substances which are poisonous to humans or in some ways limit the nutrient availability to the body. Plants evolved these substances to protect themselves and to prevent them from being eaten. However, if the diet is not varied, some of these toxins build up in the body to harmful levels (Norman and Potter, 1987). Anti-nutritional factors are present in different food substances in varying amounts, depending on the kind of food, mode of its propagation, chemicals used in growing the crops as well as those chemicals used in storage and preservation of the food substances (Kabagambo, *et al.*, 2005). Being an anti-nutritional factor is not an intrinsic characteristic of a compound but depends upon the digestive process of the ingesting animal. Trypsin inhibitors, which are anti-nutritional factors for monogastric animals do not exert adverse effect in ruminants because they are degraded in the ruminants because they are degraded in the rumen (Abulude, 2007). The importance and awareness of nutrition in public health issues has resulted in the increased demand of knowledge of the nutrients of food.

Dietary elements (commonly known as dietary minerals or mineral nutrients) are the chemical elements required by living organisms, other than the four elements carbon, hydrogen, nitrogen, and oxygen present in common organic molecules. The term "dietary mineral" is archaic, as the substances it refers to are chemical elements rather than actual minerals .Chemical elements in order of abundance in the human body include the seven major dietary elements calcium, phosphorus , potassium, sulfur, sodium, chlorine , and magnesium. Important "trace" or minor dietary elements, necessary for mammalian life, include iron, cobalt, copper, zinc, manganese, molybdenum, iodine, bromine, and selenium. Over twenty dietary elements are necessary for mammals, and several more for various other types of life. The total number of chemical elements that are absolutely needed is not known for any organisms .Ultra trace amounts of some elements (e.g., boron, chromium) are known to clearly have a role but the exact biochemical nature is unknown, and others (e.g. arsenic , silicon) are suspected to have a role in health, but without proof. Most chemical element that enters into the dietary physiology of organisms is in the form of simple compounds. Larger chemical compound of elements need to be broken down for absorption. Plants absorb dissolved elements in soils, which are subsequently picked up by the herbivores that eat them and soon, the elements move up the food chain.

Major minerals are referred to as macro-minerals and are named for the fact that you need more of them in your diet i.e. they are required in the amount of 100mg (milligram) or more. These minerals include sodium, potassium, magnesium, calcium, phosphorus, chloride and sulfur. While trace minerals are required in amounts less than 100mg per day i.e. they include; iron, copper, iodine, manganese, molybdenum, zinc, selenium, fluoride, chromium etc.

The term major and trace, however, do not reflect the importance of a mineral in maintaining health, as a deficiency of either can be harmful. Calcium, Magnesium and phosphorus are all important for the formation and maintenance of healthy bones. Some minerals compete with each other for absorption, and the interact with other nutrients as well, which can affect their bioavailability.

Trifoliate yam (*Dioscorea dumentorum*) is known as African bitter yam, cluster yam, three leaved yam etc. Trifoliate yam belongs to the family of *dioscoreaceae* (Ezeocha *et al*. 2013). It is cultivated in West Africa mainly Eastern Nigeria .Trifoliate yam has a fleshy potato-root (tuber) that is used for food in times of famine or for making medicine. However, it is not widely distributed because of the inferior quality of the tuber (Martin 1974, Coursey 1967). The tubers occur in cluster and have yellow edible flesh. The tubes are highly bitter, especially the wild ones. However, some cultivars have only a slight bitter taste and cook faster than other varieties.

(Coursely 1967; Martin and Degras 1978b). Cocoyam, *Xanthosoma atroviren* is a stem tuber that is widely cultivated in both the tropical and subtropical regions of the world. It is mostly grown in West Africa (Ihekoronye and Ngody 1985).

Cocoyam (*Xanthosoma Atroviren*) are among the top yielding crops in relation to energy and minerals (Degras, 1993). Cocoyam belongs to the monocotyledons family, *Araceae* (The aroids) which contains several plants which are cultivated and used for food in various parts of the tropics (Erdam, 1979).

According to Onwueme (1978), they are mainly herbaceous plants often with enlarged root-stock, which act as a storage organ. Morphologically, the primary corm of the plants represents the main stem and the secondary corms or cormels, lateral branches. The relative sizes of the two types of organ vary greatly between species and variety. The cormels are usually the more satisfactory item of food. Cocoyam after being processed in the local way is cherished by many people especially in the rural areas, of the southern part of Nigeria (Erubetine 2013; Iwuoha and Kalu, 1995). It is roasted and eaten with palm oil, and as a condiment in soup. Flour from cocoyam also has potentials as instant flour for “fufu” in which it is necessary to blend it with cassava and maize to reduce stickiness.

Although cocoyams are composed predominantly of starch, it is next only to certain varieties of yam in crude protein content among root crops. Cocoyam has appreciable quantities of calcium phosphorus, iron,etc. The starch grains of cocoyams are very small and easily digestible so, cocoyam dishes can form a good base for formulating infant food, and good for people with weak digestive system.

However, the nutritive value of the whole varieties and its contribution to human nutrition has not been thoroughly investigated (Wanasundera, and Ravindran 1994).

A study of the anti-nutritional factors and mineral compositions of Trifoliate yam and Cocoyam was considered necessary to determine the nutritional value of the varieties and their possible commercial uses for food.

MATERIALS AND METHODS

Raw Materials Preparation

The production of Trifoliate yam flour and cocoyam flour: The tubers were washed with clean water, peeled with sharp kitchen knives and sliced to a thickness of between 2mm to 3mm and oven-dried separately at a temperature of 65^{o}C for duration of 11 h. The dried yam slices were milled separately into flour using a hammer milling machine and sieved through a standard laboratory sieve of 500 micron meter aperture to produce uniform particle size flour.

Determination of Mineral Content

Calcium, sodium, potassium, magnesium and iron were determined according to the method of Shahidi *et al*. (1999). The sound seed samples were sieved with a 2mm rubber sieve and 2g each of samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550^{o}C, in a muffle furnace. The resultant ash was dissolved in 5ml of HNO_3/HCL/H_2O (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining materials in each crucible, 5ml of deionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into 100ml volumetric flask by filtration through a Whatman No 42 filter paper and the volume made to the mark with deionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10cm long cell was used and concentration of each element in the sample was calculated on percentage of **dry matter.**

Determination of Trace Metal

The trace metals (heavy element) zinc, iron, copper, iron was determined using the atomic analyzer method (atomic absorption spectrometer 969 instrument).

Phytate Determination

This was carried out by Reddy and Love (1999) method. Each ground sample (4g) was soaked in 100ml of 2% hydrochloric acid for 5hrs and filtered, from the filtrate, 50cm^3 was placed in a conical flask and 5cm^3 of 0.3%

ammonium thiocyanate was added. The mixture was titrated with standard iron (iii) chloride solution which contained 0.00195g iron per ml, the end point was slightly brownish yellow colour which persisted for 5 minutes.

Determination of Oxalate

Oxalate content of the sample was determined by titrimetric method proposed by Dye (1956).

Determination of Tannin: Tannins were determined by the method of Price *et al*., (1978) and Bainbridge *et al.* (1996).

Determination of Hydrogen Cyanide

Cyanide content of the sample was determined using the method described by Egan and Bradbury (1998) as modified by Onwuka (2005).

Determination of Trypsin Inhibitor

1g of ground sample was weighed and dissolved in 50ml of 0.5m sodium chloride solution. The mixture was stirred for 30min at room temperature and centrifuged. The supernatant was filtered for determination. 10ml of the filtrate was put into 250ml conical flask, with 20ml of 0.1% trypsin solution. A blank (10ml) of distilled water was prepared and allowed to stand for bout 5mins after which its absorbance was measured at 410nm. Trypsin activity was expressed as number of trypsin unit inhibited (TIV) per unit weight (g) of the sample.

RESULTS

The results of anti-nutrients and mineral compositions of flour powder and flour paste of Trifoliate yam (*Dioscorea dumentorum*) and white cocoyam (*Xanthosoma atroviren*) are shown in table1-2.

Table1: Showing comparative anti-nutrient compositions (mgl100g) of raw flour and flour paste samples of *Dioscorea dumentum* and *Xanthosoma atrovien*.

YAM VARIETIES	PHYTATE	OXALATE	TANNIN	CYANNIDE	TRYPSIN INHIBITORS
Dioscorea dumentorum (Flour Powder).	9.85±0.47	10.66±0.31	6.7±0.19	87.26±2.75	0.15±0.00
Dioscorea dumentorum (Flour Paste).	5.80±0.17	18.16±0.34	7.41±0.16	44.46±2.06	0.1±0.02
Xanthosoma atroviren (Flour Powder).	6.62±0.06	16.38±0.59	7.62±0.54	89.23±1.08	0.18±0.01
Xanthosoma atroviren (Paste Flour).	5.50±0.39	12.53±2.36	6.16±0.0.09	78.72±0.41	0.15±0.01

Table 2: Mineral compositions (mg/100g) of two flour samples (*Dioscorea dumentorum* and *Xanthosoma atroviren*).

	Ca	Mg	K	Na	P	Fe	Cu	Pb	Zn	Hg	Mn
D. dumentorum	1.11±0.29	0.39 ± 0	0.44±0.2	1.11±0.02	1.09±0.05	9.43±0.05	0.43±0.01	0.08±0.01	14.54±0.06	Trace	5.63±0.04
X. atroviren	1.11±0.15	0.380±0.04	0.30±0.04	1.15±0.00	0.93±0.00	0.93±0.00	0.43±0.06	0.05±0.01	12.08±0.18	Trace	5.01±0.71

Values are means of triplicate readings ± SEM

DISCUSSION

From the results, obtained, anti-nutrients and mineral compositions of two varieties of yam; trifoliate yam "Ono" and White cocoyam "Ede-Ocha" show that there is a significant difference between the two samples analyzed. As shown in table 1, the contents of phytate, oxalate, tannin, cyanide and trypsin inhibitor in the varieties of yam in two preparations; flour paste and flour powder were significantly different ($P < 0.05$). The effect of flour paste (cooking method) reduced some of the antinutrient contents in the yams. Whereas, some were not reduced by cooking. As reported by Owuamanam *et al* (2013), boiling, cooking, fermentation and malting increases quality of plant foods through reduction of some certain anti-nutrients in the food. In both varieties, cyanide contents were highest among the anti nutrients evaluated. Trypsin inhibitors were found to be low which could be affected by enzyme inhibitors.

Table 2**;** shows the mineral contents of *Dioscorea dumentorum* and *Xanthosoma atroviren* consisting of Ca, Mg, K, Na, P, Fe, Cu, Pb,, Hg and Mn, Hg was detected as "trace", in both the samples, zinc content was found to be the highest mineral component among the other elements. Zinc have an antioxidant- like effects on organelle based systems in vitro and play a major role in normal body development. However, in both samples, cocoyam ede-ocha possesses much value in all the elements than that of trifoliate yam.

CONCLUSION

From the evaluation of anti-nutrients and mineral compositions of two varieties of yam' trifoliate yam "Ono" and White cocoyam "Ede-ocha", it shows experimentally that anti-nutrient in both samples, flour and paste, cooking helps to reduce the anti-nutrients phytate, tannin and cyanide contents while oxalate, trypsin inhibitor, are not reduced. In two of the samples, cocoyam possesses much value of cyanide, oxalate and trypsin inhibitor whereas trifoliate yam has higher amounts of phytate and tannin. In minerals, Ca, Mg, K, Na, P, Fe, Cu, Pb, Zn, Hg and Mn are present in both yam varieties in varying quantities. Only Hg was the trace mineral element detected, though very low and Zinc has the highest value which can play a major role in the body developments.

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