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NUTRIENT AND PHYTOCHEMICAL COMPOSITION OF ADUH (*DIOSCOREA BULBIFERA*), AN INDIGINEOUS CROP

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ABSTRACT

The study investigated the nutrient and phytochemical composition of aduh (Dioscorea bulbifera), an aerial crop. Samples were subjected to proximate composition, mineral, vitamin, phytochemical and functional properties analyses. The moisture, ash, crude fat, crude fibre, protein and carbohydrate contents were 8.70%, 3.35%, 5.70%, 2.30%, 6.40% and 73.55% respectively. Data obtained for mineral composition showed that calcium, magnesium, sodium, potassium, phosphorus and iron content were 160.45mg/100g, 137.80mg/100g, 77.88mg/100g, 224.58mg/100g, 86.20mg/100g and 7.27mg/100g respectively. Data obtained for vitamin composition showed that vitamin B1, vitamin B2, vitamin B3, vitamin C, vitamin A and vitamin E were 0.24mg/100g, 0.55mg/100g, 12.48mg/100g, 3.80mg/100g, 4.33mg/100g respectively. Aduh (Dioscorea bulbifera) contains not only the essential; nutrients like protein, fat, crude fiber and carbohydrate they also contain phytochemical which help fight against most diseases of man. They also have low moisture content which makes them store for a long time. Aduh (Dioscorea bulbifera) is rich in minerals and certain vitamins. The appreciable quantities of vitamin content of the aduh (Dioscorea bulbifera) flour sample presents it as a highly potential and good source of food supplement for malnourished people and animals.

Key words: Aduh flour, nutrients, phytochemical.
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INTRODUCTION

Dioscorea bulbifera is a monocotyledonous, dioecious, herbaceous perennial vine, which has been described as one of the most aggressive weeds ever introduced into the United States (Ekop, 2008). *Dioscorea bulbifera* also known as air potato is a specie of true yam in the yam family, *Dioscoreacea.* They can be prepared in the same way as other yams, potatoes, and sweet potatoes. The family *Dioscoreacea* includes about 4-6 genera and 870 species, they are often herbaceous and climber vines. Other authors define this family in a broader context including Trichopus, genera Avetra, stenomeris and Tacca (Raz, 2003). Species in this genus are dioecious, twining and clustered large tubers some of which are edible and are known as "yams" (Acevedo-Rodriguez and Strong, 2005).

The origin of *Dioscorea bulbifera* is uncertain. Some authors believe that this specie is native to both Asia and Tropical Africa, but others believe that it is a native of Asia and that it was

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subsequently introduced into Africa (Hammer, 1998). Currently *Dioscorea bulbifera* is widely naturalized and cultivated in tropical and subtropical areas in America, It is a highly invasive plant included in the global compendium of weeds (Acevedo-Rodriguez and Strong, 2005) and which creates management problems in many parts of the world. This species reproduces sexually by seeds and vegetatively by underground and aerial tubers (bulbils) which enable it to spread rapidly and colonize entire forest in a single growing season (Langeland, 2003).

Dioscorea bulbifera was extensively introduced to tropical and subtropical regions of the world to be used as a food crop. Bulbils can last a year or more on the ground and still sprout and soil contact is not necessary for sprouting. They also float and maybe dispersed by flood and appear to be little impacted by feeding from raccons, feral pigs, and other animals (Raz, 2003). The yam specie (*Dioscorea bulbifera*) is highly neglected in the region and all over the world such that it is only consumed in the rural areas of the region often not out of preference but at periods of food scarcity. This study therefore is aimed at evaluating the nutrient and phytochemical composition of aduh (*Dioscorea bulbifera*), an indigenous crop.

MATERIALS AND METHODS

Sample procurement and preparation

The sample, Aduh (*Dioscorea bulbifera*) was obtained from Ekeonunwa market in Owerri, Imo State. The processing equipment used for processing the sample was sourced from the laboratory of the Department of Food Science and Technology. The sample (*Dioscorea bulbifera*) was sorted, peeled sliced with stainless kitchen knife and washed. The sliced samples were subsequently oven-dried at 60^{o}C for 30min. The dried sample was milled using attrition mill and sieved to obtain flour with uniform sizes and kept for further studies.

ANALYSES

Determination of Proximate Composition

The moisture, protein, fat, ash and crude fibre contents of the aduh flour were carried out according to the methods of AOAC (2010), while carbohydrate was calculated by differences.

Determination of Mineral and Vitamin Composition

Mineral content which include calcium, magnesium, sodium, potassium, phosphorus and iron contents was determined using the methods of AOAC (2005). Niacin, riboflavin and thiamine content was determined using the methods described by Okwu and Ndu (2006) while vitamins A, C and E contents of the sample were determined by procedure described by Kirk and Sawyer (1998).

Determination of Phytochemical Composition

Saponin and flavonoid contents of the sample were determined using the method described by Onwuka (2005).

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Statistical Analyses

All data obtained were expressed as the mean ± SD of three observations.

RESULTS AND DISCUSSION

Proximate Composition

The result of the proximate composition of the aduh (*Dioscorea bulbifera*) flour sample is presented in Table 1.

The result revealed that the moisture content of the aduh flour sample is 8.70%.The result obtained in this present study conforms to that of Oko and Famurewa (2015) on their work on the estimation of nutritional and starch characteristics of water yam (*Dioscorea alata*) varieties commonly cultivated in the South-Eastern Nigeria. It is believed that materials such as flour and starch containing more than 12% moisture have less storage stability than those with lower moisture content. For is this reason, a water content of 10% is generally specified for flours and other related products (Alinnor and Akalezi, 2010).

Ash content of the aduh flour sample was found to be 3.35% and fell within the range reported for other starchy roots and tubers such as yam, cassava and potatoes (Eka, 1998). Value obtained for ash content of the aduh flour sample showed that its consumption or incorporation in foods as an additive can improve the nutritional composition of such foods. The value obtained for fat content in this present study was found to be higher than the values of 1.62% to 2.41% range reported by Oko and Famurewa (2015) for water yam (*Dioscorea alata*) varieties commonly cultivated in the South-Eastern Nigeria. The crude fibre content of the aduh flour sample was found to be 2.30%. Studies have shown that increase in fiber consumption in foods reduces the incidence of obesity, cardiovascular disease, type 2 diabetes, digestive disorders and some cancers (Turner and Lupton, 2011). The mean fiber content obtained in the present study is comparable to the 3.96% reported by Shajeela *et al*. (2011) on water yam (*D. alata*). Lower values have been reported for white yam (*D. rotundata*) and white cocoyam (*Colocasia esculenta*) (Alinnor and Akalezi, 2010). The result obtained from this present study indicates that the aduh (*Dioscorea bulbifera*) sample investigated could be a source of dietary fiber with nutritional benefits.

The crude protein content of the aduh flour sample was found to be 6.40%. In earlier study carried out by Alamu *et al.* (2014), he found the protein content of *D. rotundata*; a widely cultivated and the most preferred specie of yam in Nigeria and West Africa to be within the range of 1.96% to 4.90%. This suggests a higher nutritional potential for aduh (*Dioscorea bulbifera*), at least in terms of protein content than *D. rotundata*.

The carbohydrate content obtained in this present study was 73.55%. The result is in line with the findings of Ike and Inoni(2006)which reported 76.57% and 75.65% respectively for trifolate

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yam(*D. dumentorum*) and water yam (*D.alata)*but lower when compared with the carbohydrate contents reported for red cocoyam, 86.69% and sweet potato, 86.90% (Ogbo and Agu, 2004).

Mineral Composition the Aduh (*Dioscorea bulbifera*) Flour Sample

The result of the mineral composition of the aduh (*Dioscorea bulbifera*) flour sample is presented in Table 2. The calcium content of the aduh flour sample was found to be 160.45mg/100g which was higher than the 8.13mg/100g reported for *Dioscorea rotundata* by Olajumoke *et al*. (2014), but are lower than the value (260mg/100g) reported for *Dioscorea alata* by Baah *et al*. (2009). The detected level phosphorus was lower than values report for the same species in India by Shanthakumari *et al*. (2008) and those reported by Shajeela (2011) for wild yams from Tamil Nadu in India. The disparities observed in the phosphorus content of *Dioscorea bulbifera* from Imo State, Nigeria and those from India could be due to environmental factors as well as experimental method of analysis (Osagie, 1992). Food is considered "good" if Ca/P ratio is above one and "poor" if the ratio is less than 0.5, while the Ca/P ratio above two helps to increase the absorption of calcium in the intestine (SCN, 2004). The Ca/P ratios of aduh (*Dioscorea bulbifera*) were above the recommended value of 1.00. The magnesium content of the aduh flour sample was found to be 137.80mg/100g which was found to be higher than the 18.55mg/100g to 31.53mg/100g value range reported by Oko and Famurewa (2015) for magnesium content of *Dioscorea alata* (Water Yam) varieties commonly cultivated in the South-Eastern Nigeria. Based on the result obtained in this present result, aduh could contribute adequate magnesium to the daily need of children.

Vitamin Composition the Aduh (*Dioscorea bulbifera*) Flour Sample.

The result of the vitamin composition of the aduh (*Dioscorea bulbifera*) flour sample is presented in Table 3. It was observed that the aduh (*Dioscorea bulbifera*) flour sample analyzed contains appreciable quantities of vitamins A, C, E and Niacin. This suggests a higher nutritional potential for aduh (*Dioscorea bulbifera*) in terms of vitamin content and can provide this nutrient to the consumers.

The sodium content of the aduh flour sample was found to be 77.88mg/100g which was found to be in agreement with the findings of Polycarp *et al*. (2012) on *Dioscorea rotundata* (White yam). The sodium to potassium ratio in the body is of great concern for the prevention of hypertension (Alinnor and Akalezi, 2010; Zhang *et al*., 2013). According to the World Health Organization, the sodium-to-potassium ratio should be ≤ one. The consumption of aduh (*Dioscorea bulbifera*) regarding sodium-to-potassium ratio would not promote high blood pressure.

The potassium content of the aduh flour sample was found to be 224.58 mg/100g. Value obtained in this present study for potassium was found to be lower than the 316.72mg/100g to 334.71mg/100g value range reported by Afiukwa and Igwe (2015) for potassium content of

aerial and underground tubers of air potato (*Dioscorea bulbifera*) available in Abakaliki, Ebonyi State, Nigeria.

The iron content of the aduh flour sample was found to be 7.27 mg/100g. The value obtain in this present study conforms to that of Afiukwa and Igwe (2015) on *Dioscorea bulbifera* available in Abakaliki, Ebonyi State, Nigeria. The low iron content obtained for aduh (*Dioscorea bulbifera*) could be that the plant is not a high accumulator of the elements or the soil load is minimal. According to World Health Organization, iron plays an important role as a heme molecule in red blood cells as it permits oxygen transport (Teffo *et al*., 2007), but excessive iron intake can also be a serious problem enhancing free radical activity in the body or damaging the liver (Ekop *et al*., 2010).

Phytochemical Composition of the Aduh (*Dioscorea bulbifera*) Flour Sample

The result of the phytochemical composition of the aduh (*Dioscorea bulbifera*) flour sample is presented in Table 4. Result obtained revealed that saponin content of aduh flour sample was found to be 0.12mg/100g which was found to be lower than that of fermented cassava flour as reported by Akindahunsi *et al*. (1999). High level of saponin has been associated with gastroenteritis manifested by diarrhoea and dysentery (Gernah *et al*., 2007), acute poisoning is relatively rare (Awe and Sodipo, 2001) although these toxic principles exhibit useful medicinal properties. So their presence in the aduh flour is a pointer to the medicinal value of the food material (Afiukwa and Igwe, 2015). Some general properties of saponins include formation of foams in aqueous solution, hemolytic activity and cholesterol binding properties and bitterness (Sodipo *et al*., 2000).

The flavonoid content of the aduh flour sample was found to be 0.40mg/100g. Flavonoids are potent water-soluble super antioxidants and free radical scavengers. However, moderate intake of flavonoid is essential for normal heart beat, neuromuscular and metabolic activities (Onimawo and Akubor, 2012). They also prevent oxidative cell damage, have strong anticancer activity and protect against all stages of carcinogenesis (Bello *et al*., 2008).

CONCLUSION

Aduh (*Dioscorea bulbifera*) which have been regarded as non-edible yam specie by people as a result of belief, culture or chemical constitutes has been observed from this present study to be edible. This yam specie contains not only the essential nutrients like protein, fat, crude fiber and carbohydrate; they also contain phytochemical which help fight against most disease of man. They also have low moisture content which makes them store for a long time. *Dioscorea bulbifera* is rich in minerals and certain vitamins. All the mineral elements are present in the aduh (*Dioscorea bulbifera*) flour sample analyzed were below the RDA. The appreciable quantities of vitamin content of the aduh (*Dioscorea bulbifera*) flour sample presents it as a highly potential, good source of food supplement for malnourished people and animals. Aduh

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(*Dioscorea bulbifera*) flour should be encouraged to be incorporated into food products with the aim of fortifying them owing to the presence of appreciable quantities of minerals, vitamins and phytochemicals. Aduh (*Dioscorea bulbifera*) flour should be encouraged to be incorporated into food products with the aim of fortifying them owing to the presence of appreciable quantities of minerals, vitamins and phytochemicals in them. Also, further work should be carried out on the nutritional compositions of aduh (*Dioscorea bulbifera*) flour. This will provide more insight into the commercial exploitation of aduh (*Dioscorea bulbifera*).

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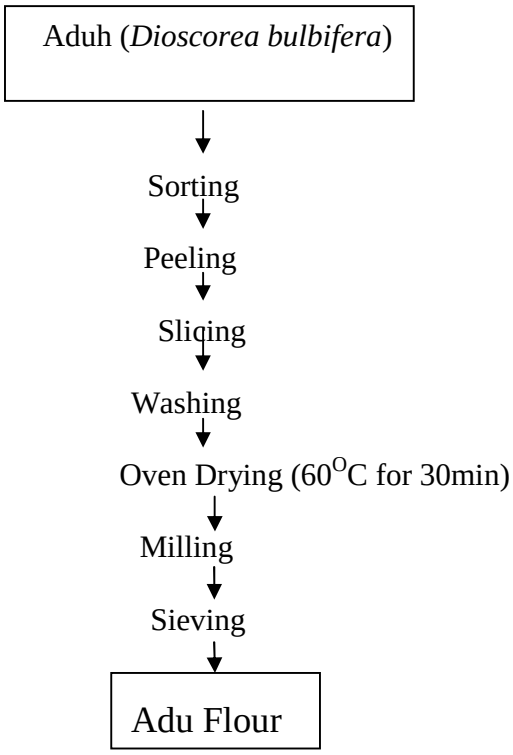

Fig.1: Preparation of Aduh Flour

Table 1. Proximate Composition of the Aduh (*Dioscorea bulbifera*) Flour Sample.

Parameter	Composition (%)
Moisture content	8.70 ± 0.10
Ash	3.35 ± 0.15
Crude fat	5.70 ± 0.10
Crude fibre	2.30 ± 0.10
Protein	6.40 ± 0.10
Carbohydrate	73.55 ± 0.35

Values are Mean ± SD of duplicate determinations

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Table 2. Mineral Composition of the Aduh (*Dioscorea bulbifera*) Flour Sample

Parameter	Composition (mg/100g)
Calcium	160.45 ± 0.00
Magnesium	137.80 ± 0.40
Sodium	77.88 ± 0.68
Potassium	224.58 ± 0.00
Phosphorus	86.20 ± 0.00
Iron	7.27 ± 0.42

Values are Mean ± SD of duplicate determinations

Table 3: Vitamin Composition of the Aduh (*Dioscorea bulbifera*) Flour Sample

Parameter	Composition (mg/100g)
Thiamine	0.24 ± 0.00
Riboflavin	0.55 ± 0.03
Niacin	1.32 ± 0.00
Vitamin C	12.48 ± 0.27
Vitamin A	3.80 ± 0.00
Vitamin E	4.33 ± 0.17

Values are Mean ± SD of duplicate determinations

Table 4: Pytochemical Composition the Aduh (*Dioscorea bulbifera*) Flour Sample

Parameter	Composition (mg/100g)
Saponin	0.12 ± 0.14
Flavonoid	0.40 ± 0.00

Values are Mean ± SD of duplicate determinations