Journal of Food Technology, 6 (5): 224-226, 2008
ISSN: 1684-8462

Nutritive and Anti-Nutritive Composition of the Wild (In-Edible) Species of *Dioscorea bulbifera* (Potato Yam) and *Dioscorea dumentorum* (Bitter Yam)

M.N. Ogbuagu
Department of Chemistry, Michael Okpara University of Agriculture, Umudike, P.M.B. 7267 Umuahia, Abia State, Nigeria

Abstract: The determination of the nutritive and anti-nutritive principles in the uncooked sand cooked wild species of Dioscorea bulifera and Dioscorea dumentorum showed that the wild yams contain all the food nutrients within the reported and acceptable values for root and tuber crops. The presence of alkaloids, oxalates and saponins at high concentrations are responsible for the qualification of the yam species as wild (poisonous) and in-edible. However, the cooking of these yam species reduced these principles to values that may earn the wild yams consideration as food for consumption.

Key words: Wild yams, *Dioscorea bulbifera, Dioscorea diementorum*, food nutrients, anti-nutrients

INTRODUCTION

Yams are among the root and tube crops of great antiquity widely distributed through out the tropics with only a few members in the temperate regions of the world (Coursey, 1967a; FAO, 1996).

Yam is a premium crop in the Nigerian food system and Nigeria is the world's largest producer with an aggregate annual output in excess of 50% of total world production (RMRDC, 1990). In Nigeria, there are about 50-60 species of yam (*Dioscorea* sp.) but only 5 or 6 species are important as food. Unfortunately, some of these food crops have been under-exploited for their food values, for example, *Dioscorea bulbifera* and *Dioscorea dumentorum.*

Dioscorea bulbifera (Potato yam) is an aerial yam. It is cultivated in the Southeast Asia, West Africa, South and Central America. The wild form also occurs in both Asia and Africa (Martin, 1974; Coursey, 1967b). The plants are characterized by the production of considerable number of aerial tubers or bulbils per plant.

Dioscorea dumentorum (Bitter yam) or trifoliate yam is cultivated in West Africa, mainly Eastern Nigeria. However, it is not widely distributed because of the inferior quality of the tubers (Coursey, 1967b; Martin and Degras, 1978). The tubers occur in clusters and have yellow edible flesh. The tubers are highly bitter especially the wild ones. However, some cultivars have only slight bitter taste and cook faster than the others.

These two yam species are mainly consumed in the Eastern part of Nigeria. The wild specie of *Dioscorea dumentorum* is consumed after series of processing while the wild specie of *Dioscorea bulbifera* is taken to be poisonous. The wild form of *Dioscorea bulbifera* is generally taken to cause madness and, in effect, in-edible.

Therefore, this study focuses on the nutritive and anti-nutritive compositions of the two species of wild yam.

MATERIALS AND METHODS

The sample materials were sourced from the Ikwuano L.G.A of Abia State, Nigeria where the University is located.

Sample preparation: The 2 samples were divided into two portions. One portion was cooked while the other portion was not cooked.

Dioscorea bulbifera wild; Db(w), was cooked and the outer covering was removed. The fleshy part was dried in the oven at 65°C, ground and screened through 1mm test Sieve to obtain the powdery cooked sample. The same method was also used to obtain the powdery sample of the uncooked yam specie.

Dioscorea dumentorum wild; Dd(w), was cooked, peeled, sliced, steeped in slow running water for 24 h, oven-dried at 65°C, ground and screened through 1 mm test sieve to obtain the powdery cooked sample: The uncooked portion was peeled and oven-dried at 65°C, ground and screened through 1mm test sieve to obtain the powdery uncooked sample. The following tests were carried out on the samples: Moisture, ash, crude protein and crude fibre content were determined according to the methods described by Pearson (1976). The minerals-

Sodium, potassium, calcium, magnesium and phosphorus were determined by the methods of James (1995). The fat (ether extract) content was determined by the method of James (1996). Saponins and alkaloids were determined by the methods of Harborne (1973) while the oxalate content was determined by the method described by Munro and Bassir (1969). The carbohydrate content was calculated by difference.

RESULTS AND DISCUSSION

Results of the analyses show that the uncooked Db(w) has higher % moisture, ether extract, crude protein, carbohydrate but lower ash and crude fibre content than the uncooked Dd(w) (Table 1). The moisture and carbohydrate contents increased while the other parameters reduced after cooking (Table 1).

The carbohydrate values of Db(w) samples; 79.15-83.21% and Dd(w) samples 78.82-82.26% (Table 1) are quite reasonable as the dry matter of most root crops is made up of about 60-90% carbohydrate (Onyenuga, 1968). The values are comparable to the carbohydrate contents of white yam, (78%), water yam, (75.65%) and sweet potato; 82.55% (Longe, 1986).

The samples are highly proteinous with values of 9.27-5.55% for the Db(w) samples and 5.95-3.41% for the Dd(w) samples. The values for the Db(w) samples and the uncooked Dd(w) sample are however, comparably higher than reported values of 5.15% for white yam, 4.88% for water yam and 3.64% for sweet potato (Alaise and Linden, 1999). But the cooked Dd(w) sample has a lower value.

The lipid content (ether extract) of the samples; Dd(w), 0.70-0.60% and Dd(w), 0.65 0.55% are quite reasonable as all root crops exhibit very low lipid content (Ekpeyong, 1984). The lipid values are comparably higher than those of white yam, 0.56% and water yam 0.48%, but lower than that of sweet potato, 0.95%.

The lipids are mainly structural lipids and are of limited nutritional importance. The lipids however, contribute to the palatability of the crops.

The fibre contents of Db(w) 1.20-0.90% and Dd(w); 1.25-1.05% are quite significant and comparably higher than that of polished rice; 0.2% (Alaise and Linden, 1999). Water yam (0.65%) and sweet potato (0.17%) have lower values of fibre content than Db(w). Fibre is regarded as essential, as it absorbs water and provides roughage for the bowels, assisting intestinal transit. Very low fibre in foods is however, helpful to digestive process but it lowers the vitamin and enzyme content of the food material. Vitamin B_1 deficiency in polished rice (with very low fibre content of 0.2%) may be the cause of beri-beri by excessive consumption of polished rice (Alaise and Linden, 1999).

The uncooked sample of Db(w) has higher % Potassium (K) and Phosphorus (P) but lower Calcium (Ca), Magnesium (Mg) and Sodium (Na) than the Dd(w) sample. The concentrations of the minerals reduced after cooking (Table 2).

The reduction of Mg concentration in Dd(w) is more pronounced (0.34-0.01%). The samples have reasonable concentration of the minerals: Na, K, Ca, but low in Mg and *P. potassium* (K) has the highest concentration in the samples. The K and Na ration is very reasonable. K is the major mineral in most root crops while Na tends to be low. The very high K and low Na ratios for Db(w); 0.86: 0.15% and 0.65: 0.14% and for Dd(w); 0.81: 0.39% and 0.58: 0.25% (Table 2) are very reasonable and are of additional nutritional benefits (Meneely and Barttablee, 1976), especially for patients with high blood pressure who have to restrict sodium intake. However, high K foods are omitted in the diets of people with renal failure.

The wild yams; Db(w) and Dd(w) are taken to be poisonous and, as such, in-edible in-spite of the fact that they contain all the food nutrients within the reported and acceptable values for root and tuber crops. This must be as a result of the presence of anti-nutritional (toxic) principles such as Alkaloids, oxalates and saponin (Table 3) at concentrations that affect animal and human health adversely; the bitterness and the irritating effects when eaten without adequate processing.

Table 1: Proximate composition of uncooked (x) and cooked (y) samples of Db(w) and Dd(w)

	Moisture (%)		Ash (%)		Ether extract (%)		Protein (%)		Crude fibre (%)		Carbohydrate (%)	
	x	y	x	y	x	y	x	y	x	y	x	y
Db(w)	7.02	7.38	2.65	2.35	0.70	0.60	9.28	5.56	1.20	0.90	79.15	83.21
Dd(w)	6.53	7.04	6.80	5.70	0.65	0.55	5.95	3.41	1.25	1.05	78.82	82.25

Table 2: Mineral Compositions of Uncooked (x) and Cooked (y) Samples of Db(w) and Dd(w)

	Calcium (%)		Magnesium (%)		Sodium (%)		Potassium (%)		Phosphorus (%)	
	x	y	x	y	x	y	x	y	x	y
Db(w)	0.32	0.25	0.22	0.08	0.15	0.14	0.86	0.65	0.033	0.026
Dd(w)	0.52	0.34	0.34	0.01	0.39	0.25	0.81	0.58	0.031	0.023

Table 3: Saponins, alkaloids and oxalates content of the uncooked (x) and cooked (y) samples

	Saponin mg/100g		Alkaloid %		Oxalate mg/100 g	
	x	y	x	y	x	y
Db(w)	79.48	24.44	0.98	0.26	2.46	0.69
Dd(w)	84.62	28.50	0.89	0.30	2.32	0.54

The uncooked Db(w) sample has higher content of alkaloids and oxalates but lower content of saponins than Dd(w). These values were reduced after cooking. However, the cooked Dd(w) sample also has higher saponin content as well as the alkaloid content (Table 3).

Most (but not all) alkaloids are toxic to animals. Many have been exploited as drugs. In spite of the medicinal uses of alkaloids, they cause gastro intestinal upsets and neurological dis-orders. However, alkaloids, including the toxic ones are found more in the wild and bitter varieties of yams (Eka, 1985).

Oxalic acid and oxalates occur naturally in plants but they have little or no useful effect on human health as high levels in diets lead to irritation of the tissues; the digestive system, particularly the stomach and kidney (Hodkinson, 1977).

Some type of saponins are health friendly. They inhibit growth of cancer cells and help to lower blood cholesterol. Hence, it is useful in the treatment of cardiovascular diseases and other health problems (Del-Rio *et al*., 1997). They act as active immune to the system, boost energy and serve as natural antibiotics (Lipkin, 1995). However, saponins are bitter and reduce the palatability of livestock feeds. Some reduce the feed intake and growth rate of non-ruminant animals. Humans generally, do not suffer severe poisoning from saponins.

The Alkaloid, oxalate and saponin contents of the samples reduced appreciably after cooking (Table 3).

The cooked sample of Db(w) has higher oxalate (0.69 mg/100 g) but lower Alkaloid (0.26%) and saponin (24.44 mg/100 g) than the cooked sample of Dd(w). Although that Dd(w) is consumed, Db(w) is believed to cause madness and in effect, is considered in-edible. This belief must be as results of the effect of alkaloids since some alkaloids are known to cause neurological dis-orders. But the cooked Db(w) sample has lower alkaloid content than the cooked sample of Dd(w).

Traditionally, Dd(w) is processed several times before consumption. The series of processing reduce the oxalate and alkaloid contents further to enable its consumption. Therefore, Db(w) with a higher oxalates content (0.69 mg/100 g) can also serve as food after series of processing to reduce the oxalate and alkaloid concentrations further.

These crops have great potentials to serve as sources of very necessary nutrients and, thus, can be applied as food for humans and animals.

REFERENCES

Alaise, C. and G. Linden, 1999. Food Biochemistry. Chapman and Hall, Food Science Book. Aspen Publishers Inc. Maryland, pp: 15, 121.

Coursey, D.G.., 1967a. Yams. An Account of the Nature, Cultivation and Utilization of Major Root Crops with special emphasis on Human, Animal, Industrial uses in "Tropical Root Crops". IDRC 22. Ottawa, pp: 25-35.

Coursey, D.G., 1967b. Yams. An Account of the Nature, Cultivation and Utilization of the useful Members of Dioscoreacea. London England. Longmans, pp: 230.

Del-Rio, A., B.G. Obudulio, J. Costillo, F.G. Mann and A. Otuno, 1997. Uses and Properties of Citrus Flavonoids: J. Agric. Food Chem., 46: 4505-4515.

Eka, O.U., 1985. The Chemical Composition of Yam Tubers: In Advances in Yam Research. The Biochemistry and Technology of Yam Tubers. Osuji G. Ed. Published by Biochemical Society of Nigeria in collaboration with ASUTECH, Nigeria, 1: 51-75.

Ekpeyong, T.E., 1984. Composition of some Tropical Tuberous Foods. Food Chem., 15: 31-36.

FAO, 1996. FAO Production Year Book, (1985). Food and Agricultural Organization of United Nations, Rome, Vol. 39.

Harbone, J.B., 1973. Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. Chapman and Hall New York, pp: 182.

Hodkinson, A., 1977. Oxalic Acid in Biology and Medicine London Academic Press, pp: 207.

James, C.S., 1995. Analytical Chemistry of Foods. Chapman and Hall New York, pp: 76-86.

James, C.S., 1996. Analytical Chemistry of Foods. Blakie Academic and Professional. Glasgow, pp: 91-92.

Lipkin, R., 1995. Science News Vol. 148, http:/www.friedu.com/herb.

Longe, O.G., 1986. Energy Content of some Tropical Starchy Crops. Nig. Agric. J., 21: 136.

Martin, F.E. and L. Degras, 1978. Tropical Yams and their Potentials. Part 6. Minor Cusltivated Dioscorea Specie. Agricultural Handbook No. 538, USDA, p. 23.

Martin, F.N., 1974. Tropical Yam and their Potentials. Part 2. Dioscorea bulbifera. Agric. Handbook, No. 466 USDA, pp: 20.

Meneely, G.B. and H.D. Barttablee, 1976. Sodium and Potassium. Nutr. Rev., 34: 225-235.

Munro, A. and D. Bassir, 1969. Oxalates in Nigerian Vegetables. W.A. J. Biol. Applied Chem., 12 (1): 4-18.

Onyenuga, V.A., 1968. Nigeria's Food and Feeding Stuffs, their Chemistry and Nutritive value 3rd edition. Ibadan University Press, Nigeria, pp: 99.

Pearsons, D., 1976. The Chemical Analysis of Foods. Churchill Livingstone Edinburgh, pp: 7-16.

RMRDC, 1990. Raw Material Sourcing for Manufacturing in Nigeria. Macmillan Publishers Nigeria, pp: 5-6.