

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

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ABSTRACT

The determination of the nutritive and anti-nutritive principles in the uncooked and cooked wild species of *Dioscorea bulbifera* 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 inedible. However, the cooking of these yam species reduced these principles to values that may earn the wild yams consideration as food for consumption.

(Keywords: wild yams, wild foods, nutrients, anti-nutrients, *Dioscorea bulbifera*, *Dioscorea dumentorum*)

INTRODUCTION

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

Yams are 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 five or six 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, and South and Central America. The wild form also occurs in both Asia and Africa (Martin,

1974; Coursey, 1967). The plants are characterized by the production of considerable numbers of aerial tubers or bulbils per plant.

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

These two yam species are mainly consumed in the Eastern part of Nigeria. The wild species of *Dioscorea dumentorum* is consumed after a series of processes 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 is, in effect, inedible. Therefore, this study focuses on the nutritive and anti-nutritive compositions of the two species of wild yam.

METHODOLOGY

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

Sample Preparation

Two 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 an oven at 65 C, ground, and screened through a 1 mm test sieve to obtain the powdery cooked sample. The same method was also used to obtain the powdery sample of the uncooked yam species.

Dioscorea dumentorum wild; Dd(w), was cooked, peeled, sliced, steeped in slow running water for 24 hours, oven-dried at 65 C, ground, and screened through a 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 1 mm test sieve to obtain the powdery uncooked sample.

The following tests were carried out on the samples: moisture, ash, crude protein, and crude fiber 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 a higher percentage of moisture, ether extract, crude protein, and carbohydrate but lower ash and crude fiber content than the uncooked Dd(w) (Table 1 (x)). The moisture and carbohydrate contents increased while the other parameters reduced after cooking (Table 1 (y)).

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 (Longe, 1986). 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 fiber 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).

Fiber is regarded as essential, as it absorbs water and provides roughage for the bowels, assisting intestinal transit. Very low fiber in foods is however, helpful to digestive process but it lowers the vitamin and enzyme content of the food material. Vitamin B₁ deficiency in polished rice (with very low fiber content of 0.2%) may be the cause of beri-beri by excessive consumption of polished rice (Alaise and Linden, 1999).

Table 1: Proximate Composition of Uncooked (x) and Cooked (y) Samples of Db(w) and Dd(w).

| Sample | % Moisture | | % Ash | | % Ether Extract | | % Protein | | % Crude Fiber | | % 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 |

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

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, and Ca, but are low in Mg and P. Potassium (K) has the highest concentration in the samples. The K and Na ratio 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% (Table 2(x)) and 0.65: 0.14% (Table 2(y)) and for Dd(w); 0.81: 0.39% (Table 2(x)) and 0.58: 0.25% (Table 2(y)) 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, inedible 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(x)) at concentrations that affect animal and human health adversely; the bitterness and the irritating effects when eaten without adequate processing.

The uncooked Db(w) sample has higher content of alkaloids and oxalates but lower content of saponins than Dd(w); (Table 3(x)). These values were reduced after cooking (Table 3(y)). 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 disorders.

However, alkaloids, including the toxic ones, are found more in the wild and bitter varieties of yam (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 types 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 compounds 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(y)).

The cooked sample of Db(w) has higher oxalate (0.69mg/100g) but lower alkaloid (0.26%) and saponin (24.44mg/100g) values than the cooked sample of Dd(w). Although when Dd(w) is consumed, Db(w) is believed to cause madness and is in effect, considered inedible. This belief must originate as a result of the effect of alkaloids since some alkaloids are known to cause neurological disorders. 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 reduces the oxalate and alkaloid contents further to enable its consumption. Therefore, Db(w) with a higher oxalates content (0.69mg/100g) can also serve as food after a series of processing to reduce the oxalate and alkaloid concentrations further.

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

| Sample | % 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.

| Sample | Saponin mg/100g | | Alkaloid % | | Oxalate mg/100g | |
|--------|-----------------|-------|------------|------|-----------------|------|
| | 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 |

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

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