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EVALUATION OF NUTRITIVE AND ANTI-NUTRITIVE COMPOSITIONS OF THE SEEDS OF *Monodora myristica (*African Nutmeg*)*

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ABSTRACT: Nutritive composition of the *Monodora myristica* (African nutmeg) showed that the seeds contained a moisture content of 4.32%, ash content 2.60%, crude fat 43.80%, crude fibre 1.70%, crude protein 7.70%, carbohydrate 44.20%, and have caloric value of 601.80kcal. Magnesium, potassium, calcium, manganese, copper, sodium, zinc, iron and phosphorous were also found to be present at the levels of 54.86 mg/100g, 68.00 mg/100g, 3.57 mg/100g, 0.80 mg/100g, 3.10 mg/100g, 3.20 mg/100g, 8.72 mg/100g, 8.76 mg/100g, and 0.04 mg/100g respectively. The anti-nutrients (toxic compounds) found in the seeds were hydrocyanic acid (HCN) 30.80 mg/100g, tannins 0.21 mg/100g, total oxalate 818.4 mg/100g, soluble oxalate 492.80mg/100g and phytic acid 0.14 mg/100g. The implications of these results are discussed.

INTRODUCTION

The human diet is a primary vehicle for interaction with the environment (Osagie and Eka, 1998). It is the major source of nutrients and can be a significant source of human exposure to infections, toxic and pharmacological agents. Furthermore, the chemical components of foods are the source of their sensory attributes and much of their capacity to be processed and stored. This information on nutrients and non-nutrients of the food has been used for a variety of purposes (Osagie and Eka, 1998).

Seeds form a major part of the diet of most Nigerians, consumed as a meal as well as ingredients (spices) of local soups (Achinewhu, 1983). Spices, according to Merwin (1992) are ingredients added to food to provide all or a part of the flavor; a unique category of flavourings which are given preferred legal status because of long history of their use in foods at all levels yield no significant nutritive value. Although, some of the spices are added to improve their quality and to replace those nutrients lost in processing the food. Some are taste enhancers, colourants and flavouring agents while some are preservatives (Kreutz, 2002).

The controversy with these substances in food is how safe are they. Although most of these substances are apparently harmless, the rapidly increasing number and types of chemicals added to our foods have increased the concern that these substances may be harmful. This creates a need for every food item taken into the body to be analysed to quantify its nutritive and anti-nutritive values (Keay *et al*, 1964). No matter how natural these substances may be, foods have their own trace amount of anti-nutrients or toxic substances such as oxalates which are harmful (Osagie and Eka, 1998). These toxic substances cause much physiological effects in the body. For instance; tannins interfere with protein digestibility; oxalates and phytates interfere with mineral availability while cyanogenic substances cause respiratory failure and goiter. These factors serve to limit nutritional potential of our foods (Osagie and Eka, 1998).

Monodora myristica (African nutmeg) seeds are consumed by many Nigerians as spices in food. However, the reports of the nutritive and anti-nutritive composition of this spice are scanty; hence the aim of this work is to determine the nutritive and anti-nutritive composition of the seed of African nutmeg.

MATERIALS AND METHOD

Collection and Treatment of Samples for Analysis

The African nutmeg (*Monodora myristica*) seeds were obtained from market in Ikot Ekpene local government Area, Akwa Ibom State, Nigeria, as dry seeds for analysis. After removing the testa, the seeds were cut into pieces and oven-dried at temperature of 60-80^{o}C. After 24 hours of drying, the dried samples were ground into fine powder using a blender mill. The ground samples were stored in an air-tight plastic plate from which the required quantities were taken for the analysis.

Determination of Proximate Composition

The methods and techniques used for the proximate analysis were those recommended by the Association of Official Analytical Chemist (AOAC, 1975). Proximate composition determined were; moisture content, ash content, crude fibre, crude fat, crude protein

Carbohydrate content of the sample was obtained after subtracting values of crude protein, crude fibre, lipid, ash contents and moisture content from 100.

Percentage carbohydrate = 100- (a + b + c + d + e)

Where a = crude protein
b = crude fibre
c = lipid value
d = ash content
e = moisture content

Caloric value of the sample was obtained by multiplying the values of crude protein, lipid and carbohydrate by 4, 9 and 4 respectively and taking the sum of the products.

Determination of Mineral Elements

Sodium and potassium were determined by flame photometery method described by Association of Official Analytical Chemist (AOAC, 1975)

Iron, Calcium, Magnesium, Copper, Zinc and Manganese were determined using Atomic Absorption Spectrophotometer.

Phosphorus was determined by calorimetric means using the anadomolybdate (yellow) Method (AOAC, 1990).

Determination of Toxic Compounds

- Hydrocyanic Acid HCN was determined using method described by AOAC, (1975).
- Tannins were determined using Burns methods (Burns, 1971).
- Oxalates: total and soluble were determined using the method described by Dye, (1956).
- Phytic acid was determined by Ferrel and Wheeler method (Ferrel and Wheeler 1969)

RESULTS AND DISCUSSION

Proximate Composition

The results of the proximate composition of the seeds are presented in Table 1

Table 1: Proximate composition of African Nutmeg seeds

Moisture content (%)	4.32
Ash (%)	2.60
Crude fat (%)	43.80
Crude fibre (%)	1.70
Crude protein (%)	7.70
Carbohydrate (%)	39.88
Caloric value (kcal)	601.80

Moisture Content

The moisture content was found to be 4.32%. This result when compared to the seeds of *Tetrapleura tetraptera* which is 14.52% (Osagie and Eka, 1998) and *Xylopia aethiopica* 8.90% (Akpan, 1988), it could be inferred that the moisture content of African nutmeg seeds is very low. This is because the seeds were obtained as dry seeds for the analysis. Water functions include easy digestion of the food, means of transportation of metabolic products and in excretion (Maynard *et al.,* 1979). The knowledge of moisture content of food stuff usually serves as an index of stability and susceptibility to microbial infection (Scot, 1956). Hence the greater the moisture content the shorter the shelf life and vice-versa.

Ash Content

The ash content of African nutmeg seeds was 2.60%. This result is at a reasonable level when compared to the ash content of *Tetrapleura tetraptera* seeds; 4.86% and Walnut 4.2% (Osagie and Eka, 1998). The ash content represents the amount of inorganic matter present in the seeds (Oyenuga, 1968).

Crude Fat

The crude fat content of African nutmeg seeds was 43.80%. This result when compared to *Tetrapleura tetraplera* seeds 8.50% and *Piper guineense* seed 5.30% (Osagie and Eka, 1998) is high. This value is low when compared to the oil seeds such as bush mango; 70.80% - 71.97% (Okolo, 1994; Osagie and Eka, 1998). According to Fisher and Bender (1977), fats are physiological, culinary and nutritively important to any living system. Dietary lipids are responsible for carrying nutritionally essential fat-soluble vitamins.

Crude Fibre

The crude fibre content for African nutmeg seeds was 1.70%. This result when compared to other seeds such as bush mango 1.40% is at reasonable level, but relatively low when compared to *Tetrapleura tetraptera* 7.76% (Osagie and Eka 1998) and *Piper guineense* 7.27% (Akpan, 1988). High fibre content in plants affects digestion. Since the crude fibre in African nutmeg is low, digestion will not be affected (Prive, 1959). Crude fibre consists largely of the cellulose together with good proportion of lignin and hemicelluloses (Inyang, 1989). Dietary fibre has been reported to have a beneficial effect in the muscles of intestine, by aiding peristalsis (Fisher and Bender, 1977). The physiological role of crude fibre is to maintain an internal digestion movement. A low diet in fibre is undesirable and it could cause constipation (Crampton and Harris, 1969).

Crude Protein

The crude protein content was 7.70% in African nutmeg seeds. This result when compared to that of *Tetrapleura tetrapera* which has a value 11.45% (Osagie and Eka 1998); bush mango 8.0 – 8.65% (Okolo, 1994; Osagie and Eka 1998), is at a reasonable level. Considering this value, it is pertinent to state that African nutmeg seed cannot be used as a supplement for protein since the value is below the recommended daily dietary allowance of 23-56g (NRC, 1974).

Protein is of importance in all biological systems, playing a wide variety of structural and functional roles. They form the primary organic basis of structure such as hair, tendons, muscles, skin and cartilage (Perlimann, 1971).

Carbohydrate Content

African nutmeg has a carbohydrate content of 39.88%. This low when compare to the carbohydrate content of *Tetrapleura tetraptera* which contained 49.91%, *Piper guineense;* 56.83%, and *Blighia unijugata* 48.79 and is comparable to that of *Xylopia aethiopica* 35.3%

(Akpan, 1988). From these results, it could be inferred that African nutmeg seeds has a reasonable amount of carbohydrate content.

Carbohydrate is a basic source of energy in all diets. It is very necessary for maintenance of the plasma glucose level; it spares the body protein being easily digested and help to prevent the using up of proteins (Corinnes, 1978). High carbohydrate content suggests high caloric energy and it can serve as food not only for man, but also for animals.

Caloric Value

The caloric value of African nutmeg seeds was 601.80 kcal. This value is relatively high when compared to that of *Tetrapleura tetrapterai* 321.94 kcal (Osagie and Eka, 1998), *Piper guineense*, 443.72 kcal, *Xylopia aethiopica* which has a value of 157.38 kcal and *Tetrapleura tetraptera* 394.37 kcal (Akpan, 1988).

Mineral Elements

Magnesium (Mg)

African nutmeg seed had a magnesium content of 54.86 mg/100g. This result is relatively low when compared to that of *Tetrapleura tetraptera* seeds with a value of 114.60 mg/100g (Osagie and Eka, 1998). Magnesium functions as the structural component of bone and plays an important role in metabolism and the regulation of muscle and nervous system. Also, magnesium is an essential part of many enzymes involved in the transfer of energy (Osagie and Eka, 1998).

Potassium (K)

The value obtained for potassium from analysis of the African nutmeg seeds was 68 mg/100g. Potassium is an essential mineral element in food stuff. The function is to maintain the normal balance and distribution of fluids throughout the body. The electrolytes, including potassium, are involved in the maintenance of normal pH balance, and work in conjunction with calcium and magnesium in the maintenance of normal muscle contracting and relaxation, and nerve transmission (Clarkson and Haymes, 1994).

Calcium (Ca)

An African nutmeg seed has a calcium content of 3.57 mg/100g. This result when compared to *Tetrapleura tetrapetra* seeds with a value of 1013.00 mg/100g (Osagie and Eka, 1998) is very low and could be neglected. The need for calcium is greater as a result of increase in skeletal mass. However, oxalates limit availability of calcium by formation of insoluble compounds or salt (Osagie and Eka, 1998).

Manganese (Mn)

The manganese content was found to be 0.80 mg/100g of sample. This value could be neglected when compared to the seeds of *Tetrapleura tetrapera* with a value of 21.0 mg/100g (Osaige and Eka, 1998). Trace amount of manganese are found in many foods we eat. But it's clearly unnecessary as supplement.

Copper (Cu)

The copper content was found to be 3.10 mg/100g. This value is comparable to *Tetrapleura tetraptera* with the value 3.70 mg/100g (Osagie and Eka, 1998). Copper is necessary (along with iron) for the formation of haemoglobin. It also helps to keep bones, blood vessels, and nerves healthy (Solomon, 1988).

Sodium (Na)

The sodium value for African nutmeg seed was 3.20 mg/100g. This result is at a reasonable level when compared to that of *Tetrapleura tetraptera* which has a value 5.0 mg/100g. As an electrolyte, its function is to maintain the normal balance and distribution of fluids throughout

the body and maintain proper pH balance of the body fluids (Clarkson and Haymes, 1994). The Food and Nutrition Board (1989) recommended a dietary sodium intake of 1.10g to 1.3g.

Zinc (Zn)

The value obtained for zinc from the analysis of African nutmeg seeds was 8.72 mg/100g. This result is high when compared to *Tetrapleura tetraptera* with a value 3.30 mg/100g (Osagie and Eka, 1998). Zinc is a mineral that has been of increasing interest to nutritionists studying human dietary requirements in recent times.

It amount and availability may be low die to binding with phytates. It is one of the most widely distributed metals in the body and is an important co-factor for more than 100 enzymes involved in metabolic pathways, endocrine functions, and immune integrity (Clarkson and Haymes, 1994).

Iron (Fe)

The value of 8.76 mg/100g of iron was obtained from the analysis of African nutmeg seeds. This result is comparatively low when compared to that of *Tetrapleura tetraptera* seeds, 19.70 mg/100g (Osagie and Eka, 1998). Iron is an essential trace element required for the formation of haemoglobin, myoglobin, the cytochromes and iron-containing enzymes critical in immune function (Haymes, 1987).

High levels of either oxalates or phytates have long been known to inhibit the absorption and utilization of mineral (including iron) by animals (Osagie and Eka, 1998). Iron deficiency leads to anemia (Guthrie, 1994).

Phosphorus (P)

The phosphorus content was 0.04 mg/100g of sample. The result could be neglected when compared to the value obtained for *Tetrapleura tetraptera* seeds which was 172.10 mg/100 (Eka and Osagie 1998). The dietary phosphorus level increases urinary excretion (Clarkson and Haymes, 1995).

Table 2: Elemental Composition of African Nutmeg Seeds

Elements	Composition (mg/100g)
Mg	54.86
K	68.00
Ca	3.57
Mn	0.80
Cu	3.10
Na	3.20
Zn	8.72
Fe	8.76
P	0.04

Toxic Substances (Anti-nutrients)

Hydrocyanic Acid (HCN)

The value of HCN in African nutmeg seeds was found to be 30.24 mg/100g. This value is at average when compared to that of African breadfruit seeds which has a value of 34.20 mg/100g (Dunu *et al*., 1986). The daily dietary requirement for HCN ranges from 25 mg/100g-50 mg/100g. The consumption of food containing high HCN could result in acute or chronic cyanic toxicity. The former is fatal resulting in a high rate mortality and morbidity, while the later has been associated with goiter. The HCN of plants could be reduced by cooking (Osagie and Eka, 1998).

Table 3: The result of the toxic substances (anti-nutrients).

Toxic Substance	Level (mg/100g)
HCN	30.24
Tannin	0.21
Total oxalate	818.40
Soluble oxalates	492.80
Phytic acid	0.14

Tannins

The tannin content of African nutmeg seeds was 0.21 mg/100g. The result is low when compared to the value of African breadfruit seeds 72.6 mg/100g (Dunu *et al*., 1986). Cooking of the seeds of African nutmeg can reduce the tannin content (Osagie and Eka, 1998).

Tannins may decrease protein quality by decreasing digestibility and palatability. It has been suggested that tannins play a major role in the plants defense against fungi and insects (Osagie and Eka, 1998).

Oxalates

The value obtained for total oxalate was 818.40 mg/100g while that of soluble oxalate was 492.80 mg/100g. The body requires only the soluble oxalate and this value is within the safety range of 400-500 mg/100g (Taylor, 1975). The value of soluble oxalate when compared to *Trecula Africana* seeds 523.90 mg/100g is at a reasonable level. High level of oxalates has long been known to inhibit the absorption and utilization of mineral elements by animals including man (Taylor, 1975). Cooking can reduce the oxalate level of the seeds. The lethal dose of soluble oxalates for man has been reported as 5-9g (Osagie and Eka 1998).

Phytic acid

The value of phytic acid obtained from African nutmeg seeds was 0.14 mg/100g. This result may be considered negligible when compared to the result obtained from African breadfruit seeds 335.70 mg/100g (Dunu *et al*., 1986). Phytate can affect digestibility by chelating with elements such as calcium or binding with substrate or photolytic enzyme (Osagie and Eka, 1998). Cooking can reduce the amount of phytic acid in the seeds (Osagie and Eka, 1998).

CONCLUSION

From the results of the experimental analysis, it was found that African nutmeg seeds had carbohydrate as its main component, closely followed by crude fat, protein, moisture content, ash and lastly crude fibre. African nutmeg seeds were also found to contain mineral elements like magnesium, potassium, calcium, copper, manganese, sodium, zinc, iron, and phosphorus.

The levels of anti-nutrients composition of the seeds were found to be minimal but total oxalate was the highest while phytic acid was the least; however, cooking could reduce these anti-nutrients content. It therefore concluded that due to the high concentration of these anti-nutrients (particularly total oxalate), the seeds of African nutmeg (*Monodora myristica*) are not good for human consumption in very large quantities but could only be added to the wide range of already available species in our foods.

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