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Research Article

Proximate and Phytochemical Composition of some *Monodora myristica* Fruits Consumed in Nigerian States

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Abstract

The samples of *Mondora myristica* seeds sourced from three locations (Anambra State, Abia State and Imo State) were analyzed for their proximate composition and antinutrients constituents. The results revealed the presence of all food fractions (protein, fibre, moisture, ash, fat and carbohydrate) in these spices. The percentage of each food fraction differed significantly ($P \leq 0.05$) in the three samples. The results suggest that these samples of *M. myristica* are good sources of the various food fractions. Antinutrients such as tannins, oxalate, phytate, alkaloids, saponins and cyanogenic glycoside were found to be present in these spices. The concentration of these antinutrients in these spices was low. Therefore, consumption of these samples of *M. myristica* will not pose any danger to human health, since none of their concentration is above the lethal dosage. The concentration of each antinutrient differed significantly ($P \leq 0.05$) in these three samples of *M. myristica*. Carbohydrate was the most abundant (39.917%) while ash was the least abundant (2.19%) proximates in the *M. myristica* samples used. Oxalate was the most abundant (18.5973 mg/100) while cyanogenic glycoside was the least abundant (0.0469 mg/100) phytochemicals in the *M. myristica* samples used. *M. myristica* sourced from Imo State had the highest alkaloid (4.06 mg/100 g), oxalate (23.232 mg/100 g), flavonoid (2.79 mg/100 g), cyanogenic glycoside (0.0617 mg/100 g) and phytate (0.3336 mg/100 g) contents, and *M. myristica* sourced from Abia State had the highest saponin (6.50 mg/100 g) content.

Keywords: African Nutmeg, *Monodora myristica*, Antinutrients, proximate and phytochemical constituents.

Introduction

African Nutmeg (*Monodora myristica* (Ehuru) belongs to the Anonacea family. Its local names in Nigeria include Ehuru or Ehiri (Igbo), Ariwo (Yoruba), Jamaica nutmeg, Calabash nutmeg, and Airama (Ekeanyanwu et al, 2010). It is a berry with many seeds grown in the evergreen forests of West Africa. *M. myristica* tree grows naturally in evergreen forests in countries like Liberia, Nigeria, Cameroon, Angola, Uganda and western Kenya. This tropical shrub is of a family of flowering plants (Okafor, 1987). The *M. myristica* tree can reach a height of 35 m and 2 m in diameter at breast height (Osuagwu and Onwuegbuchulam, 2015). The fruits are collected from wild trees and the seeds are dried and sold whole or ground to be used in stews, soups, cakes and desserts (Weiss, 2002 Celtnet Recipes, 2011). Almost every part of the tree has economic importance. The nutritional value of *M. myristica* centres on its usefulness as a seasoning because of its

aromatic flavour, and the seeds which are embedded in the white sweet-smelling pulp of the sub-spherical fruit, being the portion of interest (Uhegbu et al, 2011). The seed is reported to be used in the treatment of haemorrhoids, stomach aches and febrile pains (Ekeanyanwu et al., 2010). The seed powder is used as spices to prepare pepper soup and also used as a stimulant to relieve constipation and to control passive uterine haemorrhage in women immediately after childbirth (Bao et al., 2005). Currently, the tendency to use the oil extracted from *M. myristica* to flavour popcorn has proven to justify the use of spices as flavourings with good acceptability and no adverse effect (Enwereuzoh et al., 2015). In some places, it is used as a drug. When it was roasted and ground, seeds are rubbed on the skin for the treatment of skin diseases (Irvine, 2000). This suggests that the seeds of the plant could be germicidal or antiseptic (Rancy and Krishnakumari, 2015). The essential oil from the seed is used in pharmaceutical and dental preparation (Talalaji, 1999; Singh et al., 2005). Analysis of the phytochemical constituents of *M. myristica* is very important as the medicinal value of plants lies in the chemical substances that produce a definite physiological action in the human body. Despite its medicinal and nutritional potential, reports on the chemical composition of *M. myristica* from different states of Nigeria are scarce. The purpose of this study was to compare the proximate and phytochemical constituents of *M. myristica* fruit from three different states of Nigeria and to increase awareness of *M. myristica* potential uses and enhance its utilization.

Methodology

Source of Materials

The raw materials used in this work are the seeds of Calabash nutmeg (*Monodora myristica*). The seeds were obtained from local markets in these three locations in Nigeria; Obuohia Ibere in Ikwuano LGA, Abia State; Ihiagwa in Owerri West LGA of Imo State and Ihiala in Anambra State and were identified at sub-station of Forest Research Institute of Nigeria, Abia state, Nigeria

Chemicals and Reagents:

All chemicals used were of analytical grade and were products of May and Baker (England). The reagents used for the analysis were all Sigma products (USA).

Equipment and Instruments:

All apparatus used in this study were got from the Laboratory Unit of the National Root Crop Research Institute, Umudike, Abia State, Nigeria.

Production of African nutmeg powder:

The seeds of *M. myristica* were cleaned and shelled manually with the use of a mortar and pestle and then milled into powder using an electric blender, sieved with a 250 μm mesh and bottled in a sterile plastic container before use.

Determination of Proximate composition of *Monodora myristica* flours:
The contents of moisture, crude fat, crude fibre and total ash in the samples were assayed by the standard methods of AOAC (2005). The crude protein was determined using Lowry's method Lowry et al., (1951) as modified by Markwell et al., (1978). Carbohydrate content was determined by difference.

Determination of Physicochemical properties of the seed:
The specific gravity (using a 10ml pycnometer 25oC), refractive index (using Abbey refractometer Model TM 1600, Gibertini, Italy), iodine value, peroxide value, saponification number, unsaponifiable matter, free fatty acid and acid value were determined as described by AOAC (2005).

Analytical tool
All analyses were carried out in triplicate and the results were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS version 21). Separation of means was carried out ($P \leq 0.05$) using the Duncan Multiple Range Test.

Results and Discussion

Proximate compositions of dried seeds of *Monodora myristica*

Moisture content
Data pertaining to moisture content of dried seeds of *M. myristica* sourced from three different locations is presented in Table 1. From the result, each of the samples significantly differed from the other as they were statistically different from each other. *M. myristica* seed sourced from Abia State was statistically different from those sourced from Imo State and those sourced from Anambra State. The mean results show that the highest moisture contents of *M. myristica* seed were recorded from seeds sourced from Imo State which had (33.03%). This was followed by those sourced from Abia State (15.06%). However, the least moisture content was obtained from the *M. myristica* seed sourced from the Anambra state which had 9.210%

Fiber
From the result recorded from fiber content, seeds sourced from Imo State significantly differed from those sourced from Abia State and Anambra State. *M. myristica* seed sourced from Abia State and Anambra State were statistically the same. Mean results showed that *M. myristica* seed sourced from Imo State had the highest fiber content with a value of 5.00%. This was followed with *M. myristica* seed obtained from Abia State (4.667%). The least fiber content was recorded from those sourced from Anambra State.

Ash
Results pertaining to the ash content of dried seeds of *M. myristica* sourced from three different locations are presented in Table 1. From the result, *M. myristica* seed sourced from Anambra State was statistically different from those sourced from Imo State and those sourced from Abia State. The mean results show that highest ash contents of *M. myristica* seed was recorded from seeds sourced from Anambra State which had (2.35%). This was followed by those sourced from Abia State (2.20%). However, the least ash content was obtained from the *M. myristica* seed sourced from Imo State which had an ash content of 2.02%

Fat
Result recorded from the fat content of *M. myristica* seeds shows that seeds sourced from Imo State significantly differed from those sourced from Abia State and those sourced from Anambra State. Those sourced from Abia State and Anambra State were statistically the same as they were not different from each other. Mean results showed that *M. myristica* seed sourced from Abia State had the highest fat content with a value of 22.2%. This was

followed by *M. myristica* seed obtained from Anambra State (22.00%). However, the least fat content was recorded from *M. myristica* seeds sourced from Imo State which had the value of 16.59%.

Protein

The results recorded from protein content of *M. myristica* seeds showed that seeds sourced from Imo State is significantly different from *M. myristica* seeds sourced from Abia State and Anambra State. *M. myristica* seed sourced from Abia State and Anambra State were statistically the same as they are not different from each other. Mean results showed that *M. myristica* seed sourced from Abia State had the highest protein content with a value of 14.58%. This was followed with *M. myristica* seed obtained from Anambra State (14.14%). However, the least protein content was recorded from those sourced from Imo State.

Carbohydrate (CHO)

Result recorded from carbohydrate content of *M. myristica* seeds shows that seeds sourced from each location were significantly different from each other. Those sourced from Abia State was statistically different from those sourced from Imo State and those sourced from Anambra State. Mean results showed that *M. myristica* seed sourced from Anambra State had the highest carbohydrate content with a value of 47.72%. This was followed by *M. myristica* seeds obtained from Abia State (22.00%). However, the least carbohydrate content was recorded from *M. myristica* seeds sourced from Imo State which had a value of 30.57%.

Table 1. Effect of location on the proximate composition of *Monodora myristica* (African nutmeg) seed flour.

SOURCE OF SAMPLE	PROXIMATE (%)					
	Moisture content	Fiber	Ash	fat	protein	CHO
A (Abia State)	15.06 b	4.667 a	2.20 a	22.2 b	14.58 c	41.46 b
B (Imo State)	33.03 c	5.00 b	2.02 a	16.59 a	12.79 a	30.57 a
C (Anambra state)	9.210 a	4.58 a	2.35 b	22.00 b	14.14 c	47.72 c
MEAN	19.10	4.749	2.19	20.263	13.837	39.917

Means in the same column bearing different letter(s) differ significantly at 5% level based on Duncan's Multiple Range Test (DMRT). Phytochemical composition of *M. myristica* seed sourced from three locations. Source: Author's computation.

Tannin

Data of the tannin content of dried seeds of *M. myristica* sourced from three different locations is presented in Table 2. From the result, each of the samples significantly differed from the other as they were statistically different from each other. *M. myristica* seeds sourced from Abia State was statistically different from *M. myristica* seeds sourced from Imo State and those sourced from Anambra State. The mean results show that the highest tannin contents of *M. myristica* seed was recorded from seed sourced from Imo State which had 0.493%. This was followed by those sourced from Abia State (0.465%). However, the least tannin content was obtained from the *M. myristica* seed sourced from the Anambra state which had 0.457% tannin.

Phenol

Result recorded from phenol content shows that each of the samples significantly differed from each other as they were statistically different from each other. *M. myristica* seeds sourced from Abia State was statistically different from *M. myristica* seeds sourced from Imo State and those sourced from Anambra State. The mean results showed that *M. myristica* seeds sourced from Abia State had the highest phenol content with a value of 0.995%. This was followed by those seed obtained from Imo State (0.771%). However, the least phenol content was recorded from *M. myristica* seeds sourced from Anambra State which had phenol content of 16.59%.

Alkaloid

Result recorded from alkaloid content of *M. myristica* seeds shows that seeds sourced from each location were significantly different from each other. *M. myristica* seeds sourced from Abia State was statistically different from *M. myristica* seeds sourced from Imo State and those sourced from Anambra State with respect to alkaloid content. Mean results showed that seed sourced from Imo State had the highest alkaloid content with a value of 4.06%. This was followed by *M. myristica* seeds obtained from Abia State (2.58%). However, the least alkaloid content was recorded from *M. myristica* seeds sourced from Imo State which had the value of 2.49%.

Flavonoid

Results obtained from flavonoid content of dried seeds is presented in Table 2. From the result, *M. myristica* seed sourced from Imo State was statistically different from *M. myristica* seed sourced from Anambra State and those sourced from Abia State. The mean results show that highest flavonoid contents of *M. myristica* seed was recorded from seeds sourced from Imo State which had 2.79%. This was followed by *M. myristica* seeds sourced from Abia State (1.20%). However, the least flavonoid content was obtained from the *M. myristica* seeds sourced from Anambra State which had a flavonoid content of 1.05%.

Cyanogenic Glycoside

Result recorded from cyanogenic glycoside content shows that *M. myristica* seeds samples sourced from Imo State significantly differed from *M. myristica* seeds sourced from Abia State and those sourced from Anambra State. However, those from Abia State was statistically the same with those sourced from Anambra State. The mean results showed that *M. myristica* seeds sourced from Imo State had the highest cyanogenic glycoside content with the value of 0.0617%. This was followed by *M. myristica* seeds obtained from Anambra State (0.041%). However, the least cyanogenic glycoside content was recorded from *M. myristica* seeds sourced from Abia State which had cyanogenic glycoside content of 0.039%.

Saponin

Data recorded from saponin content is presented in Table 2. From the result obtained, all the samples of *M. myristica* seeds sourced from the three locations were statistically the same. The mean results show that highest saponing contents of *M. myristica* seed was recorded from seed sourced from Abia State which had 6.50%. This was followed by those sourced from Anambra State (6.20%). However, the least saponin content was obtained from the *M. myristica* seed sourced from Imo State which had 5.58% saponin.

Oxalate

Results obtained from oxalate content is presented in Table 2. From the result, *M. myristica* seed sourced from the three locations were statistically different from each other. *M. myristica* seed sourced from Abia State was significantly different from those sourced from Imo State and those sourced from Abia State. The mean results show that highest oxalate contents of *M. myristica* seed was recorded from seeds sourced from Imo State which had 23.232%. This was followed by *M. myristica* seeds sourced from Abia State (19.536%). However, the least oxalate content was obtained from the *M. myristica* seeds sourced from Anambra State which had oxalate content of 13.024%.

Phytate

Data regarding the phytate content of dried seeds is presented in Table 2. From the result, each of the samples significantly differed from the other as they were statistically different from each other. *M. myristica* seeds sourced from Abia State was statistically different from *M. myristica* seeds sourced from Imo State and those sourced from Anambra State. The mean results show that highest phytate contents of *M. myristica* seed were recorded from seed sourced from Imo State which had 0.3336%. This was followed by those sourced from Abia State (0.3295%). However, the least phytate content was obtained from the *M. myristica* seed sourced from Anambra state which had 0.0.2478%.

Table 2. Effect of location on the phytochemical composition of *Monodora myristica* (African nutmeg) seed.

Sample of Source	Phytochemicals			
	Tannin	Phenol	Alkaloid	Flavonoid
Abia State	0.465 a	0.995 c	2.58 c	120 a
Imo State	0.493 a	0.771 b	4.06 b	2.79 b
Anambra state	0.457 b	0.696 a	2.49 a	1.05 a
EAN	0.47156	0.8207	3.043	1.68

Means in the same column bearing letter(s) differ significantly at 5% level based on Duncan's Multiple Range Test (DMRT).

Proximate analysis studies revealed that the studied *M. myristica* samples are rich sources for the various food fractions. The values showed that out of the three *M. myristica* samples studied, *M. myristica* samples sourced from Anambra State was relatively dry (moisture contents less than 12 %) and would store for a long period of time without undue microbial and biochemical spoilage. Moisture content of any food can be used as an index of its keeping quality. Water is an important medium for most biochemical reactions. Food samples with water content of 12 % or more are more prone to high biochemical activities and usually have short shelf life (Joslyn, 1970). Fibre ranged from 4.58 % in *M. myristica* sourced from Anambra State to 5.00 % in *M. myristica* sourced from Imo State, which was observed to be relatively high. Dietary fibres are generally plant polysaccharides that cannot be digested by human digestive enzymes. Dietary fibres are either soluble or insoluble, both modulate physiological functioning and prevent some degenerative diseases in human. Fibres have been shown to reduce the incidence of coronary and breast cancer (Lintas, 1992; Effiong et al., 2005). Protein has been proven to be an essential ingredient for the survival of human beings and animals (Hunel et al., 1992). Protein is the building block and essential structural component of cells. It provides the body's required essential amino acids (Shills and Young, 1988). Protein content in food varies widely. *M. myristica* were also good sources of fat. High fat content implies high calorific value and possible presence of fat-soluble vitamins, namely vitamins A, D, E and K (Madsen and Grypa, 2000). The *M. myristica* samples showed very low ash contents. Ash content refers to the inorganic residues remaining after either ignition or complete oxidation of organic matter in the sample, and gives an overview of mineral content of the material (Joslyn, 1970). Nutritionally, ash aids in the metabolism of protein, carbohydrate and fat (Okaka, 2005). Carbohydrates are the most abundant biological molecules and play important roles in the body as sources of energy as well as provision of structural materials (Hunel et al., 1992). The results of this study indicate that the *M. myristica* sourced from Abia State and Anambra State possessed high amounts of carbohydrate and these can provide accessible fuel for physical performance and regulate nerve tissues (Onwuka, 2005). Antinutritional analysis of these *M. myristica* sourced from different locations revealed the presence of tannins, oxalate, phytate, alkaloids, saponins and cyanogenic glycoside. The concentrations of antinutrients in these *M. myristica* samples were generally low and as such, they are below the lethal dosage approved by National Agency for Food and Drugs Administration and Control (NAFDAC) in Nigeria. Akwaowo et al. (2000) reported that a daily intake of 450 mg of oxalic acid interferes with metabolism. The authors also noted that high oxalate levels in food may reduce the bioavailability of calcium. According to Munro and Bassir (1969), the lethal level of oxalate in human is 2 to 5 g per day. In this

study, the concentration of oxalate does not reach the level that could be injurious to human health. Hunel et al. (1992) reported that phytic acid intake at levels 4.00 to 9.00 mg/100 g reduces absorption by 4 to 5 fold in human. Phytate and tannins concentrations obtained in this study were very low. According to Akwaowo et al. (2000), higher intake of tannic acid has been associated with carcinogenic effect in human, poor protein utilization, liver and kidney toxicity. Consumption of any of the *M. myristica* used for this study will not pose any danger to health as their antinutrient levels do not reach to the lethal dosages. The cyanogenic glycoside content of these *M. myristica* used indicates that it will not affect human nutrition if these *M. myristica* are consumed in large quantities, since their concentrations are very low. Exposure to high concentration of cyanogenic glycoside causes respiratory track failure and death (United States Environmental Protection Agency, 1984). Anti-nutrients are required in low concentrations to effect biochemical changes; hence the sourced samples of *M. myristica* used for this study may be effective as ethnomedicine (Okaka and Okaka, 2001).

Conclusion and Policy Recommendations

This study has shown that these samples of *M. myristica* used for this study can be used as good sources of the various food fractions, like proteins and carbohydrates necessary for body metabolism despite the trace amount of anti-nutrients. The higher protein, fat, fibre and carbohydrate contents recorded from samples from Abia State and Anambra State compared to a sample from Imo State implies they could have supplementary effect for the daily nutrient and energy requirements of an average Nigerian. Based on the results obtained, all samples of *M. myristica* used recorded varying proportions of the proximate components as well as phytochemical contents. However, African nutmeg possessed better moisture, ash, crude protein, crude fat, and crude fibre contents. Based on this study, the following conclusion can be drawn;

- The three *M. myristica* samples possess varying levels of different proximate and phytochemical constituents.
- *M. myristica* samples differed significantly ($p < 0.05$) in proximate and phytochemical contents.
- Carbohydrate was the most abundant while ash was the least abundant proximates in the *M. myristica* samples used.
- Oxalate was the most abundant while cyanogenic glycoside was the least abundant phytochemicals in the *M. myristica* samples used.
- *M. myristica* sourced from Imo State had the highest alkaloid (4.06 mg/100 g), oxalate (23.232 mg/100 g), flavonoid (2.79 mg/100 g), cyanogenic glycoside (0.0617 mg/100 g) and phytate (0.3336 mg/100 g) contents, and *M. myristica* sourced from Abia State had the highest saponin (6.50 mg/100 g) content.

RECOMMENDATION

- Individual phytochemicals responsible for antioxidant activities in *M. myristica* should be characterized and identified;
- The *M. myristica* should be exploited as natural antioxidant and in real food systems.

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