THE NUTRIENT AND PHYTOCHEMICAL COMPONENTS OF *Monodara myristica* SEED

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Abstract
Background: *Monodora myristica* is one of the common herbal spices used in the ethnomedicine of the Igbo people of Southeastern Nigeria alternative medicine. It is claimed to possess valued therapeutic and nutritive properties.
Objective: The aim of this study was to determine the nutrient and phytochemical components of *M. myristica* seed, sold in Owerri, Imo State, Nigeria.
Methods: The seed was processed into spice powder before subjection to proximate, minerals, phytochemicals and terpenes evaluations using standard methods.
Results: The proximate composition found: Protein 3.85±0.10%, moisture 9.02±0.37%, fat 9.74±0.02%, ash 11.75±0.21%,crude fiber5.85±0.41% and carbohydrate64.65±1.31%. Vitamins present were Vitamin A 1.27±0.03%, Vitamin .B 0.63±0.02% and Vitamin C 0.34±0.02%.The spice contained the mineral elements potassium, sodium and magnesium in high amounts, and calcium, iron, manganese, copper and zinc in low amounts. Tannins, alkaloids, flavonoids, saponins, phytates, oxalates and phenols were the phytochemicals detected. Delta 3 carene was the major terpene detected at 0.4231% followed by rho cymene (0.2506%), alpha pinene (0.1567%), beta myrcene (0.1102%). Majority of the terpenes were present in trace amounts. The spice powder is vitamins and minerals rich.
Conclusion: The medicinal functions of the plant can be attributed to its diverse phytochemicalpotentials.
Keywords: *Monodora myristica*,proximate, minerals, phytochemicals, terpenes.

Introduction

Monodora myristicais a perennial tree *of the family Annonecea native* that thrives in evergreen forest. *I*t is known *c*olloquial as 'Ehuru' (Igbo), 'Ariwo' (Yoruba), 'Awerewa' (Hausa) and African nutmeg in Nigeria generally [1]. *M. myristica is an* important economic tree used as timber because it is hard and easy to work on [2]. The seeds which are embedded in a white sweet-smelling pulp of the sub-spherical fruit are the most economically important [3]. Studies have shown that the seeds are used as condiment for their aromatic flavour and medicinal potency. The kernel is obtained by cracking the hard nut after roasting and ground into powder for use as spice in traditional cuisines in Nigeria [4]. Ethnomedicinally, *M. myristica* is used to treat arthritis, rheumatism, haemorrhoids, cutaneous and subcutaneous infections [5]. The aromatic seeds are used widely as tonic, antiemetic, aperients, stimulant, and stomachic [6].

Spices contain nutrients required for growth and normal body functions and as such add to the bulk of nutrients in a diet to alleviate the effects of their deficiencies [7]. Spices also contain phytochemical such as alkaloids, glycosides, flavonoids, tannins, saponin and terpenes which are responsible for their medicinal properties [8-10]. *M. myristica* considered as a cheap substitute to nutmeg for the preparation of spicy meals contains several nutritional and non-nutritional compounds *[*11].Plants produce Phytochemicals which have a wide array of functions both for the benefit of animals and humans [12]. Phytochemicals are secondary metabolites found in plants that exert physiological and metabolic effects on humans, which might be beneficial for the prevention and management of several diseases [13-15]. Beneficial effect of phytochemicals against cancers, coronary heart disease, diabetes, high blood pressure, inflammation, microbial and parasitic infections, psychotic diseases, spasmodic conditions, ulcers have been reported [15,16]. Terpenes represent the largest class of phytochemicals in several plants with diverse bioactive properties [17]. Spices are increasingly finding useful applications in medicine aside their common culinary usage [8]. For the full nutritional and health benefits of any spice to be harnessed, a compositional study needs be carried out. Therefore, the aim of this study was to evaluate the nutrient and phytochemical contents of *M. myristica* spice powder sold in Owerri, Imo State, Nigeria.

Materials and Methods

Sample Collection

Monodara myristica seeds were purchased from Relief Market in Owerri Municipal, Imo state, Nigeria. The samples were identified by plant taxonomists at Imo state Polytechnic Umuagwo.

Sample Preparation

The *M. Myristica* seeds were dried at room temperature and in a cabinet oven at temperature of 60^{o}C for 30 minutes. The kernel was removed before grinding with Marlex electroline grinder to obtain a smooth powder. The preparation process is shown in Figure 1.

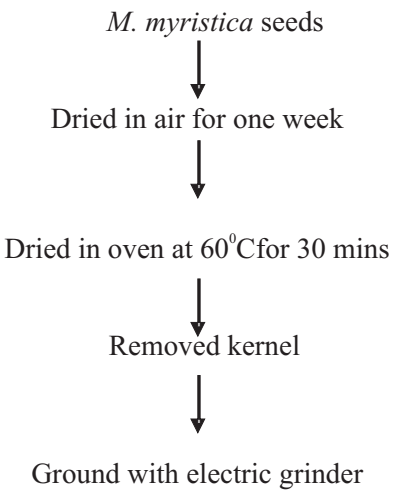

Figure 1: Flow chart for processing of *M. myristica* spice powder

Chemical analysis

The moisture, ash, fat, protein, crude fiber and carbohydrate content of *M. myristica* were determined using standard AOAC methods [18]. Vitamins A, B_1 and C were determined by Pearson [19] method. The atomic absorption spectrophotometer (AAS) method of AOAC [18] was used to determine mineral (iron, calcium, zinc, copper, manganese, sodium, magnesium and potassium) and heavy metal content of the spices. Terpene content was determined using FET headspace GC-FID according to method of Hilliard *et al*. [20].The analysis was carried out by ANRESCO Laboratories Inc., San Francisco, CA, USA.

Statistical Analysis

The data obtained from different analyses were subjected to statistical analysis using SPSS v20 to obtain mean and standard deviation.

Results

The mean was calculated from duplicate determination. Proximate composition of *M. myristica* seed presented in Table 1, revealed protein content of 3.85±0.10%,moisture 9.02±0.37, fat 9.74±0.02, ash 11.75±0.21, crude fibre 5.85.41 and carbohydrate 3.85±0.10%.

Table 1: Proximate composition of *M. Myristica* spice powder

Property	Percentage (%)
Protein	3.85 ±0.10
Moisture	9.02±0.37
Fat	9.74±0.02
Ash	11.75±0.21
Crude fiber	5.85±0.41
Carbohydrate	64.65±1.31

Table 2 shows the mineral contents (Potassium, sodium magnesium, calcium, iron, manganese, copper and zinc) evaluated.

Table 2: Mineral composition of *M. Myristica* spice powder

Property	Percentage (%)
Mg	0.266±0.02
K	1.124±0.01
Na	0.191±0.01
Ca	0.003±0.01
Mn	0.001±0.006
Fe	0.009±0.003
Cu	0.002±0.001
Zn	0.001±0.001

Table 3 shows the vitamin composition *M. myristica* spice powder. Vitamins A, B_2 and C were analyzed, with concentrations 1.27±0.03 %, 0.63±0.02 % and 0.34±0.02 % respectively.

Table 3: Vitamin composition of *M. myristica* spice powder

Property	Percentage (%)
Vitamin-A	1.27±0.03
Vitamin-B_2	0.63±0.02
Vitamin-C	0.34±0.02

Table 4 revealed the result for phytochemicals analyzed; tannins, alkaloids, flavonoids, saponins, phytates, oxalates and phenols.

Property	Result (mg/Kg)
Tannin	1.20±0.01
Alkaloid	13.42±0.13
Flavonoid	3.10±0.02
Saponin	2.84±0.07
Phytate	15.20±0.05
Oxalate	0.79±0.01
Phenol	5.50±0.14

Table 5 shows the terpene profiling result of the *M. myristica* spice powder, camphene,
Table 5: Terpene profile of *M. myristica*spice powder

Analyte	%
a –Pinene	0.1567
Camphene	ND
β-Myrcene	0.1120
β –Pinene	0.0089
d 3-Carene	0.4231
Limonene	0.0798
α-Terpinene	0.0018
Ocimene 1	0.0299
Ocimene 2	0.0366
p-Cymene	0.2506
Eucalyptol	BLOQ
y-Terpinene	0.0020
Terpinolene	BLOQ
Linalool	0.0628
Isopulegol	ND
Menthol	ND
(-)-Borneol	BLOQ
Terpineol	0.0098
Citronellol	0.0332
Geraniol	BLOQ
β –Caryophyllene	0.0049
α –Humelene	0.0031
Nerolidol 1	0.0060
Nerolidol 2	ND
Guaiol	ND
Caryophyllene Ox	ND
α -Bisabolol	ND
Eudesmol	ND
TOTAL	1.2212

ND = Not Detected; BDL = Below Detection Limit (0.0015%)

Discussion

The form and the analytical methods used in analysis can actually affect quantitative components or active ingredients in plant samples. The proximate composition of *M. Myristica* showed it contained protein 3.85±0.10%, moisture 9.02±0.37%, fat 9.74±0.02%, ash 11.75±0.21%, crude fibre 5.85±0.41%, and carbohydrate 64.65±1.31 %. The protein value (3.85±0.10) was significantly lower than previous findings[51] 12% and [52] 14.02±0.87%. This difference may be attributed to the extraction methods used [53].Soil content and period of harvest of the sample may have affected the value. Although, *M. myristica* is only added as a seasoning as such does not contribute significantly to daily protein intake. The value of carbohydrate shows that *M. myristica* seed is a good source of carbohydrate. The fat (9.74±0.02%) and protein (3.85±0.10 %) contents were low compared to values of 12.35±0.05% and 14.78 ± 0.15% reported in previous studies [21] while moisture and crude fibre contents are comparable to values of 8.78±0.02% and 4.93±0.02% in the same study. The moisture content was low which implies that the spice can be stored for a long a time without deterioration in quality or microbial spoilage. Dietary fibre helps in bowel movement to prevent constipation [22]. Fibre also have anti-inflammatory function and may contribute to reduce symptoms or bring relieve from inflammatory bowel diseases [23].

The ash content 11.75±0.21% indicates high mineral presence in the spice. Potassium, sodium and magnesium, calcium, iron, manganese, copper and zinc were the minerals present in the spice powder. Minerals constitute only 4–6% of the human body but they play critical roles in metabolism and cellular function [24]. According to Sanchez-Castillo *et al.* [25] consumption of minerals such as sodium, potassium, magnesium, calcium, manganese, copper and zinc could potentially reduce risk of cardiovascular and other diseases. Magnesium, potassium, and sodium were the most abundant and they are among the major mineral elements. Sodium and potassium are responsible for osmotic equilibrium in the body [26]. Magnesium is an essential cofactor in many enzymatic reactions in intermediary metabolism [27].

With the exception of calcium the other minerals present in trace amounts are among the trace element. Calcium is essential for bone formation, muscular, digestive and circulatory system function. The mineral also have regulatory effects on proteins and enzymes [28]. Zinc is an essential trace element needed for proper central nervous system function and for hormonal balance in the body [29]. Zinc is a co-factor in the function of enzymes and influence gene expression for protein synthesis [**30].** It has thyroid [**31**], nervous system and hormonal balance functions [**29**], and ensures stronger immunity [**32**]. Special interest is been paid to spice for their minerals and vitamin content to tackle the problem of deficiency in diet [**7**]. Vitamin A is needed for good vision, growth and development, and immune system function [33,34]. Vitamin B_2 is required for glucose, lipids and amino acid metabolism [35]. Scurvy, a disease caused by vitamin C deficiency can be prevented and treated by eating vitamin C containing diet spiced with *M. myristica*.

Tannins (1.20±0.01 mg/kg), alkaloids (13.42±0.13 mg/kg), flavonoids (3.10±0.02 mg/kg), saponins (2.84±0.07 mg/kg), phytates (15.20±0.05 mg/kg), oxalates (0.79±0.01 mg/kg) and phenols (5.50±0.14 mg/kg) were the phytochemicals detected in the seeds of *M. myristica*. Similar phytochemicals with the exception of phytate were reported present in the seeds of *M. myristica* in another study in Umuahia, Abia State [8]. Phytochemicals are known to have physiological and metabolic roles in living system [35, **8]**. Plant alkaloids have analgesic, antispasmodic and antibacterial effect [36]; flavonoids have antioxidant properties [38]; plant phenolics have antioxidant function [39]; saponins serve as expectorant and emulsifying agent [35]; tannins can inhibit microbial growth and metabolism [40] and steroid have cardiovascular and hormonal functions [41].

The *M. myristica* seeds contained Delta 3 carene, p-cymene, alpha pinene, beta myrcene, beta pinene, limonene, alpha terpinene, gamma terpinene, linalool, citronellol, terpineol, beta caryophylleneocimene 1, alpha humelene, nerolidol 1, ocimene 2 and and p-cymene. Nguefack [2] reported that the seeds of *M. myristica* contained alpha phellandrene which was not detected in this study and alpha pinene, myrcene, limonene and beta pinene which were detected.

Terpenes are the largest class of chemical compounds in plant [17]. They have gained much attention because of their importance in plants physiology as structural compounds and for the defensive role they play in plant ecology [42,43]. These volatile aromatic compounds are beneficially to man industrially as solvents, cleaning agents and as flavour and fragrance additive [**44, 45**]. In medicine, alpha-pinine regarded as one of the most potent and widely distributed terpene among plants, functions as bronchodilator, anxiolytic, anti-cancer, anti-inflammatory and antimicrobial agent [46]. P-cymene is reported to have anti-inflammatory and antidiabetic effect [47]. Limonene is used in traditional medicine to provide relieve from heartburn, gallstone and gastro-esophageal reflux disease [48]. Intake of 1000 mg of d-limonene has been shown to reduce symptoms of gastro-esophageal reflux disease [49]. Safety and toxicity report suggest that high doses of terpenes can cause allergic dermatitis [45], affect fertility and reproductive performance [50].

Conclusion

From a nutritional view point seeds of *M. myristica* is rich in minerals and vitamins which have nutritional benefits. Though they are part of the major staples consumed, their nutritional quality makes them important in supplementing the vitamins and minerals present in diets to which they are added. They also contain several beneficial phytochemicals which have functional properties as antioxidants. The challenge in

the use is to produce it in commercial quantities and forms which will have easy introduction in our delicacy

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