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Evaluating the Nutrient and antinurient composition of *Monodora myristica* (NUT MEG) for use as feed additive

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Abstract

A research work was carried out to evaluate the nutrient and anti-nutrient composition of raw and toasted Monodora myristica spice to be used as feed additive. The proximate, vitamin and mineral composition and anti-nutritional factors were evaluated. The result from proximate analysis showed that raw *Monodora myristica* had moisture (10.10%), dry matter (89.90%), ash (8.84%), crude fibre (9.64%), ether extract (28.60%), crude protein (15.75%), nitrogen-free extract (37.17%) and Gross energy (469.08kcal/kg) while toasted noted moisture (8.24%), dry matter (91.76%), ash (9.40%), crude fibre (6.24%), ether extract (21.54%), crude protein (25.38%), nitrogen-free extract (37.44%) and Gross energy (445.14kcal/kg) respectively. Vitamin and mineral composition of Raw *Monodora myristica* noted ascorbic acid -184.60(g/100g), thiamin-0.77(mg/100g), riboflavin-0.15(mg/100g), niacin-18.00(mg/100g), calcium- 4.62%, magnesium-2.01%, sodium-0.45%, potassium-1.20%, phosphorus-0.61%, nitrogen-2.52%, copper-23.24(mg), zinc-98.20(mg), iron-15.82(mg), lead-0.30(mg) while the toasted had ascorbic acid -240.46(g/100g), thiamin- 0.98(mg/100g), riboflavin-0.14(mg/100g), niacin-16.44(mg/100g), calcium- 5.22%, magnesium-2.01%, sodium-0.33%, potassium-1.38%, phosphorus-0.78%, nitrogen-4.06%, copper-19.15(mg), zinc-25.26(mg), iron-14.51(mg), lead-0.26(mg). The anti-nutrient contents of raw *Monodora myristica* noted alkaloid-4.14(mg), flavonoid-12.88(mg), saponin- 0.32(mg) and tannin-0.31(mg) while toasted recorded alkaloid-3.84(mg), flavonoid-11.45(mg), saponin- 0.29(mg) and tannin-0.18(mg) respectively. A significant difference ($p<0.05$) was observed in the nutrient and anti-nutrient composition of raw and toasted *Monodora myristica* seed.

Keywords: Evaluating, Nutrient, antinurient, composition, *Monodora myristica*.

Introduction

Monodora myristica is a perennial edible plant of the annonaceae family that grows wild in the evergreen forest of west Africa (ATSDR, 2015) and is widely distributed from Africa to Asia, Central and South America (Ameh *et al* 2016). *Monodora myristica* has the common names of African nutmeg and calabash nutmeg and in Nigeria, it is called "Ehuri" in Igbo "Abolakoshe" in Yoruba and "Ebenoyoba" in Benin (Bouba *et al* 2012).

However, the most economically important parts of the plant is the seeds which are embedded in the white, sweet-smelling pulp of the subspherical fruit (Dike, 2010). The seeds have nutritive and calorific values that make them necessary in diets. The kernel obtained from the seed has an aromatic fragrance which makes it suitable as a spicing agent in the diets of birds (Dike, 2010). Spices are pro-nutrients that make up the largest and most important group of feed additives (Wenk, 2003). According to Rosen (1996), pro-nutrients are micro feeding stuffs used orally in relatively small amounts to improve the intrinsic value of the nutrient mix in an animal diet. Even at low levels, the pro-nutrients can contribute to the nutrient requirement of man and animal.

The history of animal feed flavours dates back to 1946, when these were first used under practical farm condition (Esmail, 2004). These additives have been widely accepted for cattle, sheep, pig and other farm stock. However, the use of spices in poultry feed especially quails has not gained much popularity. Scientists have almost, always been cautions or event reluctant of using spices as flavours in poultry feeds. Their objection is based mainly on the argument that the number of taste buds in chicken is small (8 in a day old chick; 24 at 3 months of age and 40 in adult birds) and not well developed according to Holdas and May (1966).

Esmail (2004) reported that chickens find tannin in sorghum distasteful. The fact that the number of taste buds in chicken increases with age simply means that they have well defined taste mechanisms (Leeson, 2002; Esmail, 2004). Although, such mechanisms may not be fully utilized due to insufficient solubilization of flavouring agents upon ingestion, the feel of the flavor could be enhanced further by the smell sensation evoked by the presence of the substance in the mouth. Spices and their extracts have been used since ancient times not only for increasing flavor of feeds but also for their preservative and medicinal properties (Gordon and Wenk, 1992; Kim *et al*, 1994). In the last few years, the modern western world has learnt that spices can play a significant role in the health and nutrition of animals Esmail (2004). The number of studies with spices, herbs and botanicals has increased, especially in Europe (Wenk, 2003), even though, there are not many results available on the transition and bio-availability of spices and herb ingredients, especially African Nutmeg (*Monodora myristica*).

This research work investigates the nutritional potentials of *Monodora myristica*

Materials and Methods

Source of *Monodora myristica* and Processing

The study commenced with the procurement of the test ingredient *Monodora myristica*. Seeds of *Monodora myristica* were bought from Ndoro market in Ikwuano Local Government Area of Abia State. They were cleaned and toasted for 30 minutes at 65^{0}C milled into powder and bottled in air tight container for the chemical analysis and for the feeding trial.

Proximate Composition Analysis

Determination of the proximate composition of the test ingredient was carried out according to the procedure of A.O.A.C. (1990) using the microkjeldahl method for protein and soxhlet extraction procedure for ether extract. Gross energy of the sample was done by the use of the Adiabetic oxygen Bomb calorimeter technique.

Mineral Content Determination

The milled seeds were subjected to wet digestion with perchloric and nitric acids by the Johnson and Ulrich (1959) method. Following the digestion, calcium, sodium and magnesium content were determined by atomic absorption spectrophotometry. The phosphorus content was determined on a spectronic 20 spectrophotometer, following the development of colour with ammonium molybdate. The result was expressed on a dry matter basis.

Vitamin Content Determination

The Thiamine, Riboflavin and Niacin content were determined using Scalar Analyse 918 Solar Model while the ascorbic acid was determined using the method of Barakat *et al* (1973) as outlined by Okwu (2004).

Determination of anti-nutritional Factor

Some of the anti-nutritional factors of interest were tannin, saponin, alkaloid and flavonoid.

Tannin Determination

Tannin was determined using the procedure of Van-burden and Robinson (1987). 50mg of the sample was weighed into 100ml plastic bottle. 50ml of distilled water was added and shaken for 2 hours in a mechanical shaker. This was filtered into a 50ml volumetric flask and mark. Then 5ml of the filtrate was pipette out into a tube and mixed with 3ml of 0.1 M $FeCl_2$ in 0.1 N HCl and 0.008M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 120nm wavelength and the colour developed and read at the same spectrophotometer. A standard was prepared using tannic acid.

Saponin Determination

The saponin content was determined according to the procedure outlined by Obadori and Ochuko (2001). 20g of the sample was dispersed in 200ml of 20% ethanol. The suspension was heated over a hot bath for 4 hours with continuous stirring at about 55^0C. The mixture was filtered and the residue re-extracted with another 200ml of 20% ethanol. The combined extracts were reduced to 40ml over water bath at about 90^0C.

The concentrate was transferred into 250ml separator funnel and 20ml of diethyl ether added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. Purification process was repeated and 60ml of n-butanol was added. The combined n-butanol extracts was washed twice with 10ml of 5% aqueous sodium chloride.

Alkaloid Determination

5g of the sample was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol added and covered to stand for 4 hours. This was filtered and the extract concentrated using a water bath to a quarter of the original volume. Concentrated ammonium hydroxide was then added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate collected, washed with dilute ammonium hydroxide solution and then filtered. The residue was the crude alkaloid, which was weighed (Obadori and Ochuko, 2001).

Flavonoid Determination

10g of the sample was extracted repeatedly with 10ml of 50% aqueous methanol at room temperatures. The whole solution was filtered through whatman filter paper (No 42-; 125mm). The filtrate was later transferred into crucible and evaporated to dryness over a water bath and weighed to a constant weight (Bohkam and Kocipia, 1974).

RESULTS AND DISCUSSION

Chemical Composition of African Nutmeg (*Monodora myristica*) Spice

Table 1: Proximate Composition of raw and toasted *Monodora Myristica* (% DM basis)

Nutrient Content	Raw	Toasted	SEM
Moisture content (%)	10.10	8.24	1.78
Dry matter (%)	89.90	91.76	1.90
Ash (%)	8.84	9.40	0.60
Crude fibre (%)	9.64	6.24	0.87
Ether extract (%)	28.60	21.54	2.34
Crude protein (%)	15.75	25.38	9.02
Nitrogen-free extract (%)	37.17	37.44	0.08
Gross energy (Kcal/kg)	469.08	445.14	20.89

Values are means of three determinations.

The proximate composition of raw and toasted *Monodora myristica* is presented in Table 1.0 The proximate analysis revealed that the composition was improved by toasting the spice. Toasting reduced the moisture content in the raw *Monodora myristica* from 10.10% to 8.24. The toasted *Monodora myristica* recorded 25.38% crude protein, 37.44% NFE and 9.40% Ash as against 15.75% crude protein 37.17% NFE and 8.84% ash, indicating an improvement in the spice by toasting. There was a reduction in the ether extract from 28.60% to 21.543% and in crude fibre from 9.64% to 6.24% as a result of toasting the *Monodora* spice. Raw *Monodora* was observed to contain higher crude fibre content than the toasted spice. The reduction in ether extract could be due to the volatilization of oil due to the applied heat from toasting. The reduction in the crude fibre of the toasted *Monodora* seeds indicates that toasting could reduce the fibrous and less digestible carbohydrate fraction of the spice from 9.64% to only 6.24%. The gross energy was slightly reduced in the toasted *Monodora*. The reduction in ether extract explains the low value of gross energy observed in the toasted *Monodora* since fats are high in specific energy ingredients and contribute about two and half times as much energy as carbohydrate or protein in feeds. The general increase in the crude protein, nitrogen free extract and ash could be due to loss of moisture and volatilization of oils through toasting and the observed reduction in crude fibre. Also, the increase in the alkaloid content as shown in Table 4.3 resulting from toasting may have contributed to the increased crude protein since crude protein comprise not only true proteins but also other substances containing nitrogen. The crude protein, ash and NFE values observed in this study were higher than those reported by Okwu (2001a) and the deficiency could probably be from the processing procedure. The spice used in this experiment was toasted at a temperature of 65^{0}C for 4hours, while *Monodora* reported by Okwu (2004) was sun dried.

Vitamin and Mineral Composition of raw and toasted *Monodora Myristica*

Table 2 represents the vitamin and mineral composition.

The vitamin composition of the raw *Monodora myristica* as observed were ascorbic acid (180.60g/100g), thiamin (0.77mg/100g), riboflavin (0.15 mg/100g) and niacin (18 mg/100g) while the toasted *Monodora myristica* recorded 240.46g/100g ascorbic acid, thiamin (0.98mg /100g), riboflavin (0.14g/ 100g) and niacin (16.44g /100g). The raw *Monodora myristica* contained 4.618% calcium, 2.006% Magnesium, 0.45% sodium, 1.3% potassium, 0.613% phosphorus 23.24% copper and 15.82% iron while the toasted *Monodora myristica* recorded 5.22% calcium, 2.00% magnesium, 0.33% sodium, 1.38% potassium, 0.78% phosphorus, 25.26% zinc, 14.50% iron and 19.15% copper.

The vitamin B's (thiamin, riboflavin and niacin) were not significantly ($p>0.05$) affected by the heat from toasting. Toasting reduced ($p>0.05$) the riboflavin (vitamin B_2) and niacin levels. However, there was also an improvement in the contents of some vitamins of the spice arising from the toasting as was observed in the ascorbic acid content. While toasting significantly improved the ascorbic acid content, it increased thiamin only slightly ($p>0.05$). This observation is in line with the report by McDonald *et al.*, (1995) that ascorbic acid is heat-stable but dissolves easily in water. The high value of ascorbic acid in the toasted *Monodora* seed is an indication that the toasted spice if used as feed additive can protect the birds from oxidative damage by scavenging free radicals more than the raw spice and this can be useful in reduction of stress. The high value of thiamine is an indication that the appetite of the bird could be improved since thiamine deficiency has been reported to cause poor appetite (McDonald *et al*., 1995). Thiamin also plays major role in oxidative decarboxylation of pyruvic acid, so it would help to reduce the accumulation of pyruvic acid and its reduction product lactic acid in the tissues, thereby reducing the occurrence of muscular weakness.

There was no significant differences ($p>0.05$) in all the mineral contents of the raw and toasted *M.myristica* except in the zinc content. Toasting was observed to increase ($p>0.05$) the nitrogen, calcium, potassium and phosphorus contents while there was a significant ($p<0.05$) reduction in copper. It has been reported that copper in excess to animals are toxic (McDonald *et* al., 1995). The improvement, though statistically insignificant in the calcium and phosphorus imply a good structural role for the birds with respect to the egg shell and the bones.

The reduction in iron content of toasted *Monodora* seeds implies that, if it is used in poultry feed, it may likely result in a decrease in the haemoglobin formation more than the raw spice, since iron present in the body occurs as haemoglobin.

Table 2 Vitamin and mineral composition of raw and toasted *Monodora myristica*

Parameters	Raw	Toasted	SEM
Ascorbic acid (g/100g)	184.60	240.46	11.06
Thiamin (mg/100g)	0.77	0.98	0.44
Riboflavin (mg/100g)	0.15	0.14	0.03

Niacin (mg/100g)	18.00	16.44	4.20
Mineral Composition			
Ca (%)	4.62	5.22	1.30
Mg (%)	2.01	2.01	0.03
Na (%)	0.45	0.33	0.12
K (%)	1.20	1.38	0.23
P (%)	0.61	0.78	0.43
N (%)	2.52	4.06	3.13
Cu (mg)	23.24	19.15	3.40
Zn (mg)	98.20	25.26	4.57
Fe (mg)	15.82	14.51	1.30
Pb (mg)	0.30	0.26	0.09

Values are means of three determinations.

Anti- nutritional contents of raw and toasted *Monodora myristica*

The results of the anti nutritional components are presented in Table 3. The alkaloid, flavonoid, saponin and tannin contents of raw *Monodora myristica* were 4.14%, 12.88%, 0.32% and 0.31% respectively while the toasted *Monodora myristica* recorded 3.84%, 11.45%, 0.29% and 0.18% for alkaloid, flavonoid, saponin and tannin respectively. The raw *Monodora myristica* seed was observed to have significant ($p<0.05$) higher values of flavonoid, saponin, tannin than the toasted spice.

The higher level of flavonoid observed in the raw *Monodora myristica* may imply higher anti- inflammatory activity. The flavonoid from spices has been reported to have been effectively used in the treatment of arthritis in herbal medicine (Okwu 2001). Flavonoid from *Magnifera indica* has also been reported to aid protection against allergies, inflammation and free radical scavengers (Okwu and Ezenagu, 2008). Saponin was reported to have the ability to lower blood plasma cholesterol (Osagie, 1998). The alkaloid contents were observed to be higher ($p>0.05$) in the raw *M.myristica* seeds. The light bitter taste observed in the raw *Monodora myristica* is attributed to the high level of alkaloid which has been noted for bitter taste (Osagie *et al.*, 1996). It could be that toasting was not adequate for the reduction of the alkaloids as much as simple boiling as reported by Osagie *et* al., (1996). The value of the toasted *M.myristica* was observed to be similar to that reported by Castelli (1998). Alkaloids have been reported to be soluble in water but highly poisonous (McDonald *et al.*, 1995). The anti nutritional contents observed in this study were higher than the 0.22% alkaloid, 0.01% saponin, 0.11% flavonoid and 0.02% tannin reported by Okwu (2001). The difference may have been from the processing method used for this study. The *M. myristica* was toasted in this study while the spice was boiled in the study conducted by Osagie *et al.*, (1996), boiled (Okwu, 2001) and sundried (Okwu, 2004).

Table 3 Anti-nutritional contents of raw and toasted *Monodora myristica*

Anti nutrients	Raw	Toasted	SEM
Alkaloid (mg)	4.14	**3.**84	0.6
Flavonoid (mg)	12.88[b]	11.45[a]	0.52*
Saponin (mg)	0.32 [b]	0.29[a]	0.12*
Tannin (mg)	0.31 [b]	0.18 [a]	0.51*

***** SEM .Standard Error of Mean. Values in the table are means of three determinations.

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