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Effect of Different Processing Methods on the Chemical Composition and Organoleptic Properties of African Nutmeg (*Monodora myristica*)

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Abstract: African Nutmeg seeds were subjected to three different processing methods to produce flour. The different processing methods were roasting, boiling, and boiling/roasting. The samples were subjected to proximate, minerals antinutrients and organoleptic evaluations using standard methods. The proximate composition is as follows protein 12.71-14.78%, Ash 2.91-3.85%, moisture 8.78-9.55%, fat 9.37-14.83%, Fiber 4.35-4.93% and carbohydrate 53.80-61.71%. The highest value for the crude protein, fiber and ash were recorded for roasted African nutmeg. The mineral composition analysed were phosphorus, iron, zinc, sodium, calcium and magnesium. All the data obtained were significantly different with the processing methods used and the control samples (raw) at $p < 0.05$. All the determined antinutrient (Alkaloid, oxalate, tannin and phytate) decreased with boiling. The organoleptic evaluation revealed no significant difference in appearance and texture of the raw, roasted, boiled and boiled/roasted cake spiced with African nutmeg. The highest scores for the attributes studied were recorded for cakes spiced with boiled African nutmeg and the boiled sample was most significantly preferred ($p < 0.05$). This work showed that acceptable cake could be produced using the different processing methods with boiling giving better results in terms of organoleptic evaluation of the cake.

Keywords: African Nutmeg, Proximate, Antinutrient, Minerals, Spices, Organoleptic

1. Introduction

Spices could be a seed, leaf, fruit, root, bark or other plant substances usually dried and used to season food because of the distinguished flavor, color or preserving effect. Indigenous spices are used generally to prepare pepper soup which are hot and spicy especially during cold seasons [12]. Most species are added to food recipes primarily to function as seasoning rather than for its nutritional benefits [8]. Among these spices are the seed of *monodora myristica* popularly known as African nutmeg.

African nutmeg (*monodora myristica*) belongs to the *Ananacea* family. It is a many seeded berry that grows well in evergreen forest of West Africa mostly in the southern part of Nigeria [1]. It has other English names like calabash nutmeg and Jamaican nutmeg. It's local names are Ehuru (Igbo), Ariwol (Yoruba) and Awerewa (Hausa) [8]. The kernel obtained from African nutmeg seed is a popular condiment used as a spicing agent in both African and continental cuisines in Nigeria [7]. African nutmeg are aromatic and are used after grinding to a powder as a condiment in food providing flavor resembling that of nutmeg (*myristica fragrans)* [7].

African nutmeg is rich in energy, carbohydrate, protein, dietary fiber, vitamin A, C and E [9]. Potassium, phosphorus, calcium and magnesium etc. of African nutmeg were the most predominate minerals [7]. African nutmeg is also rich in alkaloid, glycosides, flavonoids, tannins, saponins and steroids [16]. The objective of this study is to ascertain the effect of different processing methods on the chemical and

organoleptic properties of African nutmeg.

2. Materials and Methods

2.1. Samples Collection and Preparation

African nutmeg seed was purchased from Eke-ukwu market in Owerri municipal council of Imo state, Nigeria with other materials used. The samples were prepared in accordance with the method of [6]. The seeds were sorted to remove bad and decomposed seed and then cleaned. A specific weight was weighed out and the different samples were prepared based on the different processing method stated below;

Two hundred gram (200g) of the sample were boiled in 50 mls of water for 20 mins and dehulled. Another 200g were roasted for 15 minutes in dry heat. The third sample of 200g were also boiled for 5 minutes and roasted for 10 minutes and dehulled. While the last sample of 200g were dehulled raw. All the samples were subjected to dehydration by sun-drying method.

2.2. Proximate Analysis

The proximate analysis of the samples were determined using standard procedure of [3]. Triplicate samples were used for moisture content in a hot air circulating oven (Galenkamp). Ash was determined by incineration (550°C) of known weight of the samples in a muffle furnance (Hot box oven, Gallencamp, UK size 3). Crude fat was determined by exhaustively extracting known weight of sample in petroleum ether (boiling point, 40 to 60°C) using Tecatorsoxtec (model 2043 (20430001). Protein content (Nx6.25) was determined using the micro-kjeldahl. Crude fiber was determined after digesting a known weight of fat free sample in refluxing, 1.25% sulfuric acid and 1.25% sodium hydroxide.. Carbohydrate content was determined by difference.

2.3. Mineral Analysis

The mineral content was investigated according to [3]. Calcium (Ca), magnesium (mg), zinc (zn) and iron (fe) were determined using Atomic absorption spectrophotometer (AAS model sp 9). Sodium (Na) were determined using flame emission photometer (Sherwood flame photometer 410, sherwood scientific Ltd. Cambridge UK) using NaCl and KCl as the standard. Phosphorus was determined using vanodo-molybdate method.

2.4. Antinutrient Analysis

Quantitative determination of oxalate, phytate, alkaloid and tannin were carried out using the method of [3].

2.5. Preparation of Cakes

The cakes were prepared using the method of [5].

2.6. Organoleptic Properties

Twenty five man panelist was drawn from usual cake consumers to access the quality attributes of the cake the sample was presented with coded letters in identical white plate. The panelist was instructed to assess the sample based on 9-point hedonic scale ranging from 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, and 1-dislike extremely as describe by [10].

2.7. Statistical Analysis

All data obtained was statistically analysed using the one way ANOVA (Analysis of variance). The data was expressed as mean ± standard deviation. The mean was tested for significant at 5% level ($p < 0.05$) using LSD.

3. Result and Discussion

3.1. Proximate Composition

Table 1 shows the results of the proximate composition of African nutmeg flour. The moisture content ranged from 8.78-9.55%. This is comparable with the mean value of moisture content of legume ranging from 8.01%-12.97% as reported by [15]. Roasting reduces the moisture content to 8.78 ± 0.02%. This may be as a result of moisture lost by evaporation. The crude fat ranged from 9.37-14.83. This value is low when compared with 43.2% for calabash kernel [13], and 23.5% for soy bean seed [14]. The carbohydrate content ranged from 53.80-61.77%. This result showed that African nutmeg is a good source of carbohydrate.

Table 1. *Proximate composition (%) of African nutmeg seed flour.*

Composition	Raw	Roasted	Boiled	Boiled/Roasted	LSD
Moisture	$9.55^{a} \pm 0.01$	$8.78^{b} \pm 0.02$	$8.87^{b} \pm 0.09$	$8.90^{b} \pm 0.03$	0.22
Dry matter	$90.65^{b} \pm 0.01$	$91.22^{a} \pm 0.02$	$11.13^{c} \pm 0.01$	$91.10^{a} \pm 0.03$	0.22
Ash	$3.46^{b} \pm 0.01$	$3.85^{a} \pm 0.01$	$2.96^{d} \pm 0.01$	$3.12^{c} \pm 0.01$	-
Crude fiber	$4.79^{b} \pm 0.01$	$4.93^{a} \pm 0.02$	$4.19^{d} \pm 0.02$	$4.35^{c} \pm 0.05$	0.13
Fat	$14.83^{a} \pm 0.04$	$12.35^{c} \pm 0.05$	$9.37^{d} \pm 0.03$	$13.72^{b} \pm 0.07$	0.13
Crude protein	$13.79^{b} \pm 0.02$	$14.78^{a} \pm 0.15$	$12.85^{c} \pm 0.01$	$12.71^{d} \pm 0.01$	0.30
Carbohydrate	$53.80^{d} \pm 0.02$	$55.31^{c} \pm 0.21$	$61.77^{a} \pm 0.13$	$57.20^{b} \pm 0.07$	0.22

Values are mean ± standard deviation of triplicate determination.

The crude protein (14.78%), ash (3.85%), crude fiber (4.93%) and dry matter (91.22%) of the roasted African

nutmeg was the highest. This showed that roasting slightly increases the protein, ash and fiber content. This may be due to the stability of this compounds during dry heating. The lower value of crude protein, ash, crude fiber and dry matter in boiled African nutmeg as compared to the roasted, boiled/roasted and raw form recorded in this research might be as a result of leaching of the nutrients. [8] stated that the seeds of *monodora myristica* has a balanced nutritional composition.

3.2. Mineral Composition

The mineral content (mg/100g) of African nutmeg in Table 2 shows that the roasted samples had the highest value, this indicates that roasting slightly increases the mineral content (phosphorus, calcium, sodium and magnesium) of African nutmeg. The most abundant minerals in their different processing methods are phosphorus 115.86mg/100g, calcium 84.29mg/100g, magnesium 61.72mg/100g respectively. This is in agreement with the works of [4] who opined that phosphorus, calcium and magnesium were the most predominant minerals in Nigeria plant foods.

Table 2. *Mineral composition (mg/100g) of African nutmeg flour.*

	Raw	Roasted	Boiled	Boiled/Roasted	LSD
Phosphorus	$114.62^{b} \pm 0.27$	$115.86^{a} \pm 0.32$	$109.43^{d} \pm 0.18$	$112.69^{c} \pm 0.09$	0.49
Iron	$5.16^{a} \pm 0.20$	$4.77^{b} \pm 0.02$	$3.86^{d} \pm 0.03$	$4.15^{c} \pm 0.01$	0.16
Zinc	$1.61^{a} \pm 0.01$	$1.53^{b} \pm 0.00$	$1.15^{d} \pm 0.01$	$1.27^{c} \pm 0.01$	-
Sodium	$15.72^{b} \pm 0.01$	$17.86^{a} \pm 0.32$	$12.81^{d} \pm 0.03$	$14.28^{c} \pm 0.03$	0.16
Calcium	$78.75^{b} \pm 0.21$	$84.29^{a} \pm 0.26$	$73.76^{c} \pm 0.13$	$69.45^{d} \pm 0.58$	0.91
magnesium	$58.75^{b} \pm 0.15$	$61.72^{a} \pm 0.24$	$49.53^{d} \pm 0.26$	$53.81^{c} \pm 0.03$	0.40

Values are mean ± standard deviation of triplicate determination

3.3. Antinutrient Content

The concentration of antinutrients are shown in Table 3. The result revealed that phytate had the lowest value (0.08 ± 0.00mg/100g) with boiling method. The reduction of phytate by boiling is necessary as high concentration could cause adverse effect on the digestibility [2]. Phytate forms stable complexes with Cu^{2+}, Zn^{2+}, Co^{2+} Mn^{2+}, Fe^{2+} and Ca^{2+} respectively. Oxalate and tannin were quiet low with boiling method. This shows that boiling reduces/removes antinutrients in food. This could also suggest that the antinutrients leached into the water.

Table 3. *Antinutrient content (mg/100g) of African nutmeg flour.*

	Raw	Roasted	Boiled	Boiled/Roasted	LSD
Alkaloid	$0.79^{b} \pm 0.01$	$1.33^{a} \pm 0.01$	$0.30^{d} \pm 0.01$	$0.45^{c} \pm 0.00$	-
Oxalate	$0.41^{b} \pm 0.01$	$0.64^{a} \pm 0.01$	$0.14^{d} \pm 0.01$	$0.26^{c} \pm 0.00$	-
Tannin	$0.53^{b} \pm 0.01$	$0.79^{a} \pm 0.01$	$0.10^{d} \pm 0.01$	$0.18^{c} \pm 0.01$	0.04
phytate	$0.30^{b} \pm 0.01$	$0.46^{a} \pm 0.01$	$0.08^{d} \pm 0.00$	$0.13^{c} \pm 0.00$	0.04

Values are mean ± standard deviation of triplicate determination

3.4. Organoleptic Properties

The organoleptic properties of different cakes seasoned with nutmeg are shown in Table 4. There was no significant difference in appearance and texture of the raw, roasted, boiled and boiled/roasted cake spiced with African nutmeg. Cakes spiced with boiled African nutmeg had the highest score value in appearance (8.16), aroma (8.00) and taste (7.84) while the cakes spiced with English nutmeg had the lowest score value in all the attributes. The appearance, texture, aroma, taste and overall acceptability of cakes prepared with African nutmeg flour was higher and better than that of English nutmeg and zero nutmeg spiced cakes respectively. The mean value was much higher and generally acceptable compared to what [11, 17] stated in their different reports.

Table 4. *Organoleptic properties of cakes seasoned with different nutmeg flour.*

	Raw	Roasted	Boiled	Boiled/Roasted	English nutmeg	Zero nutmeg	LSD
Appearance	$7.80^{a} \pm 0.91$	$7.72^{a} \pm 1.10$	$8.16^{a} \pm 0.62$	$7.16^{b} \pm 1.28$	$6.44^{c} \pm 1.48$	$7.56^{b} \pm 1.34$	0.52
Textue	$7.52^{a} \pm 1.10$	$7.56^{a} \pm 1.00$	$7.56^{a} \pm 0.87$	$6.88^{b} \pm 1.30$	$6.24^{c} \pm 1.35$	$7.48^{a} \pm 1.16$	0.52
Aroma	$7.64^{c} \pm 1.35$	$7.72^{bc} \pm 0.89$	$8.00^{a} \pm 0.96$	$7.80^{b} \pm 0.91$	$7.16^{e} \pm 1.65$	$7.44^{d} \pm 1.23$	0.12
Taste	$7.80^{a} \pm 1.19$	$6.96^{c} \pm 1.46$	$7.84^{a} \pm 0.09$	$7.16^{b} \pm 1.14$	$6.52^{d} \pm 1.15$	$7.72^{a} \pm 1.16$	0.13
Overall acceptability	$8.00^{a} \pm 0.94$	$7.44^{bc} \pm 1.00$	$7.96^{a} \pm 0.79$	$7.08^{cd} \pm 1.04$	$6.84^{d} \pm 1.29$	$7.72^{ab} \pm 1.43$	0.47

Values are mean ± standard deviation of triplicate determination

4. Conclusion

The study established the chemical composition and organoleptic properties of African nutmeg flour after subjected into, roasting, boiling, and boiled/roasted. The findings showed that roasting slightly increases the nutritional components and boiling reduces the antinutrients. The cake spiced with African nutmeg was better than that

spiced with English nutmeg or zero nutmeg. Cakes spiced with African nutmeg could be used for commercial production.

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