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NUTRITIONAL AND PHYTOCHEMICAL COMPONENTS OF THREE *Aframomum species*

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ABSTRACT

Aframomum species (*Aframomum danielli, Aframomum melegueta and Aframomum sceptrum*) are used traditionally as medicine and food preservatives. Currently, these *spp* have been noted to have antiparasitic, antifungal and antiviral properties. This study was designed to validate the nutritional and phytochemical components of the three species of *Aframomum*. The phytochemical, mineral, proximate and vitamin components were analysed using standard laboratory techniques. The antioxidant activity of the seeds of the three samples was used against 2, 2-DiphenylPicrylhydrazl ($DPPH^+$). Means were based on triplicate readings. The three *Aframomum* spp. contained appreciable nutrients especially carbohydrates, crude fibre and protein. *A. danielli* had the highest carbohydrates content (50.1%), *A. melegueta* had the highest crude fibre (18.03%) and protein (12.7%) contents. The samples were rich in minerals, *A. meleguta* had the highest potassium (63.3mg/100g), magnesium (35.0mg/100g) and calcium content (225.0mg/100g). The samples contained considerable ß- carotene content in the order *A. sceptrum* > *A. danielli* > *A. meleguta*. The three species contained phytochemical in varied concentrations, *A. meleguta* had the highest alkaloids (823.3mg/100g), tannins (378.3mg/100g) and proanthocyanidins contents (3.5mg/100g). Also, the cardiac glycosides were the highest in *A. sceptrum (*45.0mg/100g) whereas *A. danielli* had the highest anthraquinones (238.3mg/100g). *A. meleguta* was the richest in polyphenols whereas *A. sceptrum* showed highest inhibition against $DPPH^+$. The usage of this seeds could be useful in the management of diseases due to oxidative stress, and obesity. *Aframomum danielli* has been over exploited hence, there is a need to consider other species of Aframomum.

Keywords*: Aframomumsp,* ß-carotene, nutrients, ascorbic acid, concentration,

Introduction

Aframomum species of the family Zingiberaceae, is a perennial herb with short stems, highly branched with lanceolate leaves and adventitious roots (Okujagu, 2008). In tropical Africa, and indeed Nigeria, the plant is cultivated mainly for its use in ethno medicine than as a spice (Norton, 2004). The seeds of this indigenous spice have also been found to contain phytochemicals (Fasoyiro and Adegoke, 2007) which is use as medicine, preservatives for herbal medicine and food. *Aframomum* species are aromatic plants, the seeds of are nutritionally rich, containing high concentrations of calcium, potassium, iron as well as vitamins (thiamine, riboflavin, niacin and ascorbic acid) that confer medicinal properties to the plant (Okwu and okpara 2005).

Aframomum melegueta (Alligator Pepper, Grains of Paradise) is an herb where the seeds have traditional usage mostly as a pungent spice to season foods. This herb is botanically in the same family as Ginger and shares many bio-actives, and has been (medicinally speaking) traditionally used mostly for digestive and

intestinal health with some other sporadic uses not related to food. *Aframomum melegueta* appears to have some anti-diabetic and anti-obese mechanisms, although neither is remarkable (the one human study conducted in humans has confirmed an increase in metabolic rate, but required both cold exposure as well as brown fat on the person in question as prerequisites). *Aframomum sceptrum is* wide-spreading, inflorescences at foot of leafy shoots or at some distance away. The whole plant has been reported to be used for ethno dietary, medicinal and spiritual purposes (Burkill, 1985). Locally the pods are crushed to remove the seeds which are then fermented. However, in spite of its huge economic potential in the food, herbal medicine and pharmaceutical industries, the species is still conserved *in- situ* in the wild and on farmers' fields. While *in-situ* conservation allows the maintenance and co-evolution of viable species in natural environments, it also exposes the species germ plasm to both biotic and abiotic stresses. With rapid depletion of the tropical rainforest coupled with emerging climate change, *in-situ* conservation poses a serious threat to the continuous survival of this economically important plant in the wild. Considering the importance of these seeds, which are commonly used in herbal medicine, it is necessary to investigate the nutritional and phytochemical components of the seeds of *Aframoum melegueta, Aframomum sceptrum, Aframomum danielli*.

This study investigates the fundamental scientific basis for the use of these seeds by determining the nutritional and phytochemical components as well as the antioxidant activity, vitamins and mineral constituents of the seeds.

Materials and Methods

Mature seeds of *Aframoum melegueta, Aframomum sceptrum, Aframomum danielli* were purchased from Oja-oba market in Ibadan Oyo state, Nigeria. The species were identified at the Department of Botany Herbarium, University of Ibadan. The seeds were sorted to ensure uniform size of 1g. Fifty seeds of each species seeds were grinded using milling machine to powdery form. The powdery form was used for all analysis which was performed using the samples of each species.

Proximate Analysis of the *Aframomum species*

Moisture, protein, fat, carbohydrate, ash and crude fibre were determined in accordance with the standard methods of Association of Official Analytical Chemists (AOAC, 2000).

Moisture Content

Moisture content determination was carried out using oven dry method. Crucibles were firstly washed and dried in an oven. The crucibles were allowed to cool in the desiccator and weighed empty. 3g of each samples were then transferred into the three crucibles per species sample and dried at a temperature between 103-105^{o}C. The dried samples were cooled in a desiccator and the weights were recorded. They were later returned to the oven and the process continued until constant weight was obtained.

Determination of Ash content

A known weight (1.5g) of finely ground sample from each species was weighed into clean, dried previously weighed crucible with lid (W1). The sample was ignited over a low flame to char the organic matter with lid removed. The crucible was then placed in muffle furnace at 600^{o}C for 6hours until it ashed completely. It was then transferred directly to desiccators, cooled and weighed immediately (W2).

$$Percentage\ Ash = \frac{W2 - W1\ X\ 100}{Weight\ of\ sample}$$

Determination of Crude Fat

The soxhlets extraction method according to AOAC (1996) was used. This method could only give the approximate fat content in a sample because all the substances soluble in chosen solvent (Petroleum ether, 40^0 C – 60^o C boiling range) were extracted from the sample. A known weight (2g) of each sample was weighed into a weighed filter paper and folded neatly. This was put inside pre-weighed thimble (W1). The thimble with the sample (W2) was inserted into the soxhlets apparatus and extraction under reflux was carried out with petroleum ether (40^oC – 60^oC boiling range) for 6hours. At the end of extraction, the thimble was dried in the oven for about 30 minutes at 100^o C to evaporate off the solvent and thimble was cooled in a desiccator and later weighed (W3).

The fat extracted from a given quantity of sample was then calculated:

$$Percentage\ fat = \frac{Loss\ in\ weight\ of\ sample\ X\ 100}{original\ weight\ of\ sample}$$

Protein Content Determination

Protein content was determined in the form of total nitrogen using AOAC (2000) as outlined below:

Principle: The kjeldahl method of determining total nitrogen involves first heating with concentrated H_2SO_4 in a long – necked digestion flask. The reaction rate was accelerated by adding of Sodium or potassium sulphate which served as catalyst to raise the boiling point. The oxidation caused the nitrogen to be converted to ammonia sulphate. After making alkaline with concentrated NaOH solution, the ammonia is distilled into either excess boric acid or standard acid (such as H_2S0_4) and is estimated by titration.

Procedure

Digestion of sample: Approximately two grams of the sample was weighed into kjeldah flask containing the sample. Afterwards, 20ml of concentrated H_2S04 was added .The flask was then set up in a slanting position on the kjeldahl digestion heating mantle and then in the fume cupboard until the colour changes from black to bluish green. The digest on the flask was removed from the fume cupboard and allowed to cool .The digest was diluted with distilled water and made up to 200ml. The blank was also prepared using the same procedure above with the exception of the sample.

Crude Fibre

Two hundred mills of freshly prepared 1.25% H_2SO_4 were added to a known weight (3g) of the residue obtained from fat extraction and boiled for 30 minutes. The mixture was filtered and residue washed until it was free from acid. The residue was transferred quantitatively into a digestion flask. 1.25% NaOH was added and brought to boiling point quickly. Boiling was continued for 30 minutes. The mixture was filtered and residue washed free of alkali. The residue was then washed with methylated spirit, thrice with petroleum ether using small quantities. It was allowed to properly drain and the residue was transferred to a silica dish (previously ignited at 60^oC and cooled). The dish and its content were dried to constant weight at 105^oC. The organic matter of the residue was burnt by igniting for 30 minutes in a muffle furnace at 600^oC. The residue was cooled and weighed. The loss on ignition was reported as crude fibre

Carbohydrate

The carbohydrate content was calculated by difference.

% CHO = 100-(Sum of the percentages of moisture, ash, fat, protein and crude fibre)

A=%protein
B=%fat
C=%fibre
D=%ash
E=% moisture

% carbohydrate
100-(A+B+C+D+E)

Mineral Analysis of the selected *Aframomum species*

Sodium and potassium determined using a flame photometer (corning, UK, Model 405), other metals were determined by means of atomic absorption spectrophotometer (Buck Scientific Inc., Connecticut) while phosphorus was determined colorimetrically (AOAC,2000). All the chemicals used was of analytical grade and obtained from British Drug House (BDH, London)

Quantitative Analysis of Phytochemicals

The seed of the three selected species of *Aframomum* were prepared and subjected to preliminary phytochemical screening as describe by Harbone (1998) by using different reagents for identifying the presence of various phyto constituents viz: alkaloids, tannis, saponin, flavonoids, carotenoids, anthraquionones and proanthocyanidins. These samples were taken to the laboratory for analysis and the above phyto constituents were tested as per the standard method.

Terpenoids

Sample (1g) was weighed into 10ml Petroleum Ether. Allowed to extract for 15min, filtered Absorbance was read at a wavelength of 420nm.

Flavonoids

One gram of extract with 10ml of 80% methanol was Left to stand for 2 hours. Filtered into a weighed Petri dish. Left to dry in the oven at 40^0c and weighed when dried to constant weight.

Determination of Total Flavonoids

0.5ml of 2% $AlCl_3$ Methanol solution was added to 0.05ml sample solution. After 1hour at room temperature, the Absorbance was measured at 420nm on spectrophotometer. Yellow colour indicates Flavonoids. Calculated Flavonoids content as mg/g Quercetin form calibration curve.

Tannins

One g of the sample with 25ml of the solvent mixture of 80:20 Acetone: 10% Glacial Acetic Acid for 5hours. Filtered and measured the Absorbance at 500nm. Make a standard graph with 10, 20,30,40,50 mg/100g of Tannic Acid. Read off the concentration of Tannin taking into consideration any dilution factor.

Alkaloids

One g of sample was added to 20ml of 10% acetic acid in ethanol. Shake and allowed to stand for 4 hours Filtered. The filtrate was evaporated to about a quarter of its original volume; a drop of concentrated Ammonia was added. The precipitate was filtered the through a weighed (W1) filter paper. The filter paper was left to dry in the oven at 60^0C after which the weighed filter paper was dried to a constant weight (W2)

$$Percentage\ Alkaloids = \frac{W2 - W1\ X\ 100}{Weight\ of\ sample}$$

Phenols/Phenolics and Antioxidants – (Extraction)

Extract (2ml) was mixed with 20ml of 80:20 Acetones: 0.5% formic Acid for 2min and filtered, or Phenols/Phenolics/Phenolic Acids 2ml of the extract is mixed with 0.5ml of Folin-Ciocalteau Reagent and 1.5ml Sodium Carbonate (20%). Mixed for 15 seconds and allowed to stand at 40^0 c for 30 minutes to develop colour.

Carotenoids

One gram of the sample was weighed into 20ml Acetone and Left for 1hour and filtered. 10ml of water was added to the filtrate, the filtrate was poured into a separating funnel. 5ml Petroleum Ether was added to the funnel allowing it to flow into

it by the side of the funnel and left for some minutes to be separated. The lower layer was discarded; Absorbance was measured at 440nm and read off a standard graph.

Saponins

One gram of sample was added to 5ml of 20% ethanol and put in a water bath at 55^{o}C for 4hours. Filtered and washed the residue with 20% ethanol twice. The extract was reduced to about 5ml in the oven. 5ml of Petroleum Ether was added to the concentrated extract inside a separating funnel. Petroleum Ether layer and 3ml of butanol was added to it, washed with 5ml of 5% Sodium Chloride. The butanol was later poured into a weighed petri dish. Put in the oven to evaporate to dryness and the residue was weighed.

Anthraquinones

5ml of extract was mixed with 1ml of benzene, filtered and 5ml of 10% NH_3 of solution was added to filtrate. The mixture was shaken and presence of pink, red and violet colour in ammoniac (lower) phase indicated the presence of anthraquinones.

Proanthocyanidins

The method described by Sun *et al*. (1998) was used to evaluate the Proanthocyanidins in the samples.0.5ml or 1mg/ml extract was mixed with 3ml of vanillin-methanol (4% v/v) and 1.5ml hydrochloric acid. The mixture was left for 15minutes at room temperature and the absorbance was read at 500nm.the result was expressed at Catechin Equivalent (CE) (mg) using the calibration curve equation Y=0.5825 X R^2 =0.9277, where X is the absorbance and Y is the Quercetin equivalent.

Antioxidant Analysis

The free radical scavenging ability of the plantain extract against DPPH (2, 2-diphenyl-1-picrylhydrazyl) free radicals was evaluated according to Gyamfi *et al.(*1999). 600ml of extract was mixed with 600ml of methanolic solution containing DPPH (0.3mM) radicals. The weight of each sample was determined experimentally for each matrix. Erlemeyer flask was used for each sampled to be analysed and was labelled at the screw cap, the flask for two blanks, four trolox calibration standard and four reference material. 0.2, 0.4, 0.6 and 0.8ml of the trolox was pipetted into respective labelled 125ml screw cap Erlemeyer flask. 50ml DPPH solution was added and incubated at 35^{o}C.The sample was removed from the shaker, filtered through a Whatman no 4 filter paper, the cleared samples was continually assayed .The absorbance was read on spectrophotometer at 516nm against distil water blank within 30minutes of removal from the orbital incubator.

Statistical Analysis

The study consisted of three treatments replicated three times. Data collected were subjected to Analysis of Variance using and the homogeneity of means was done using Duncan multiple Range Test (DMRT). Data were represented as mean $\pm$ standard deviation.

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Results

Table 1: Proximate composition of the three *Aframomum species*

Parameters	*Aframomum melegueta*	*Aframomum danielli*	*Aframomum sceptrum*
Moisture Content (%)	10.77±0.49[a]	10.27±0.15[a]	10.53±0.21[a]
Protein (%)	12.77±0.15[a]	7.77±0.15[c]	9.73±0.21[b]
Ether Extract (Fat)%	13.23±0.25[b]	11.67±0.15[c]	16.17±0.15[a]
Ash (%)	7.93±0.15[a]	6.43±0.15[c]	6.77±0.15[b]
Crude Fibre (%)	18.03±0.25[a]	13.77±0.15[c]	15.60±0.36[b]
Carbohydrates (%)	37.27±0.06[c]	50.10±0.40[a]	41.2±0.46[b]

Means are based on triplicate reading

Proximate analysis of the *Aframomum species*

The three samples were high in carbohydrates, rude fibre, and ether extract (fat). The moisture content of *A. melegueta, A. danielli* and *A. sceptrum* were not significantly different from each other. It was observed that the protein, ash and crude fibre of *A. melegueta* was significantly (p = 0.05) higher than *A. danielli, A. sceptrum*. The ether extraction (fat) of *A. sceptrum* was significantly higher than that of *A. melegueta, A. danielli*. Also, the carbohydrates content of *A. danielli* was significantly higher than that of *A. melegueta* and *A. sceptrum*.

Table 2: Mineral composition of the three *Aframomum species*

	Mineral Composition (mg/100g)		
Parameters	***Aframomum melegueta***	***Aframomum danielli***	***Aframomum sceptrum***
Mg^{++}	35.00±5.00[a]	25.00±5.00[a]	30.00±5.00[a]
Zn^{++}	0.77±0.06[a]	0.53±0.06[b]	0.50±0.10[b]
Ca^{++}	225.0±5.00[a]	136.67±7.64[c]	168.33±10.41[b]
Na^{+}	568.33±7.64[b]	421.67±7.64[c]	618.33±7.64[a]
K^{+}	43.33±2.89[b]	63.33±2.89[a]	35.00±5.00[c]
Fe^{++}	13.50±0.30[a]	9.03±0.15[c]	11.47±0.15[b]

Means are based on triplicate reading

The mineral composition of the *Aframomum species*

The three samples showed appreciable amount of mineral composition. The magnesium content of *Aframomum melegueta*, *A. danielli and A. sceptrum* was not significantly (p = 0.05) different . Also, the composition of zinc was significantly higher in *A. melegueta* (0.77 ± 0.06) while that of *A. danielli and A. sceptrum* was not significant (0.53±0.06 and 0.50±0.10). It was observed that the calcium content was significantly (p = 0.05) higher in *Aframomum melegueta* (225.0 ± 5.00) compared to *A. danielli* and *A. sceptrum*. The sodium and potassium content was significantly (p = 0.05) higher *Aframomum sceptrum* (618.33 ± 7.64) compared to the other species of *Aframomum* selected for the bio-treatment experiment. The detectable level of iron in *Aframomum melegueta* (13.50±0.30) was significantly higher compared to *A. danielli and A. sceptrum*.

Table 3: Vitamin composition of the three *Aframomum* species

	Vitamin Composition (mg/100g)		
Parameters	***Aframomum melegueta***	***Aframomum danielli***	***Aframomum sceptrum***
Ascorbic Acid	8.63±0.21[a]	5.17±0.15[c]	6.77±0.15[b]
Thiamine	0.07±0.01[c]	0.12±0.02[a]	0.09±0.01[b]
Riboflavin	0.11±0.02[b]	0.15±0.02[a]	0.11±0.01[b]
Niacin	2.37±0.21[c]	2.73±0.06[b]	3.33±0.15[a]
ß-Carotene (µg/100g)	155.0±13.23[c]	190.0±5.00[b]	221.67±10.41[a]

Means are based on triplicate reading

Vitamin composition of the *Aframomum species*

The composition of Vitamin C (Ascorbic acid) in percentage was significantly (p = 0.05) higher in *Aframomum melegueta* (8.63 ± 0.21) than *A. danielli and A. sceptrum*. Also, Vitamin B1 (Thiamine) and B2 (Riboflavin) was significantly higher in *A. danielli* (0.12 ± 0.02) and (0.15 ± 0.02) respectively than the other species. Niacin and ß-carotene was significantly (p = 0.05) higher in *A. sceptrum* (3.33 ± 0.15) and (221.67 ± 10.41) respectively.

Table 4: Phytochemical composition of *Aframomum species* used for the preservation experiment

Parameters	*Aframomum melegueta*	*Aframomum danielli*	*Aframomum sceptrum*
Alkaloids (mg/100g)	823.33±20.21[a]	716.67±10.41[b]	448.33±12.58[c]
Flavonoids (mg/100g)	248.33±17.56[a]	273.33±12.58[a]	211.67±10.41[b]
Saponins (mg/100g)	43.33±10.41[c]	275.00±18.03[b]	310.00±5.00[a]
Tannins (mg/100g)	378.33±17.56[a]	226.67±7.64[b]	166.67±7.64[c]
Cardiac Glycosides (mg/100g)	35.00±5.00[b]	23.33±2.89[c]	45.00±5.00[a]
Proanthocyanidins (QE)	3.57±0.15[a]	1.70±0.10[c]	2.37±0.15[b]
Anthraquinones (mg/100g)	211.67±7.64[c]	531.67±7.64[a]	238.33±12.58[b]

Means are based on triplicate reading

Phytochemical analysis of the *Aframomum species*

The phytochemical composition of the three (3) *Aframomum species* (*Aframomum melegueta, A. danielli and A. sceptrum*). The alkaloid composition of *A. melegueta* (823.33 ± 20.21) was significantly (p = 0.05) higher. *A. melegueta* (248.33 ± 17.56) and *A. danielli* (273.33 ± 12.58) had similar flavonoids composition compared to *A. sceptrum* (211.67 ± 10.41).

The saponins content of *Aframomum sceptrum* (310.00 ± 5.00) was significantly (p = 0.05) higher compared to *A. melegueta*, and *A. danielli*. It was also observed that the tannin composition of *A. melegueta* (378.33 ± 17.56) was significantly higher than *A. danielli and A. sceptrum*. The cardiac glycosides, proanthocyanidins and anthraquinoneswas not significant in *A. sceptrum* (45.00 ± 5.00), *A. melegueta* (3.57 ± 0.15) and *A. danielli* (531.67 ± 7.64).

Table 5: Polyphenol and antioxidant inhibition against $DPPH^+$ of the three *Aframomum species*

Parameters	*Aframomum melegueta*	*Aframomum danielli*	*Aframomum sceptrum*
Polyphenol (mg GAE/g)	38.43± 4.21[a]	26.47±1.41[b]	22.63±2.58[c]
Antioxidant (Inhibition against $DPPH^+$ %)	55.67±10.56[a]	54.43±10.58[b]	55.43±9.41[c]

Means are based on triplicate reading

Polyphenol and antioxidant composition of the species of *Aframomum* used

The antioxidant content was in the order *Aframomummelegueta (55.6%) > A. danielli (55.6%), > A. sceptrum (55.4%)*. The level of polyphenol present in *Aframomum melegueta, A. danielli and A. sceptrum* was significantly (p = 0.05) different. However, *Aframomum melegueta* was significantly (p = 0.05) higher in polyphenol content (38.4mgGAE/g) than *A. danielli* (26.4mgGAE/g) and *A. sceptrum* (22.64mgGAE/g).

Discussion

The seeds of the *Aframomum* samples contained valuable amount of nutrients, result from this work showed that the seeds of *Aframomum* are highly nutritious with no significant differences in the moisture content of the plant samples. Hence, high moisture content helps in maintaining the protoplasmic contents of the cells but also make botanicals perishable and susceptible to spoilage by microorganisms during storage (George, 2008). The crude protein *of A. melegueta* was the highest compared to the other selected species; this was higher that what Okwu and Okwu, (2004) reported on the crude protein content. *A. sceptrum* was relatively high in fat compared to other selected species, therefore it is could be considered as a good source of crude fat which is needed in the body. The ash content is higher in *Aframomum melegueta* than in the other selected species; the presence of ash content in diet could be used in treating obesity (Okwu 2004). The same observation was noted for that of crude fibre composition.

Mineral elements such as Phosphorus, Calcium, Magnesium, Potassium, Iron and Zinc play important roles in health and well-being of human. The presences of Zinc content could mean that the seeds can play a valuable role in the management of diabetes, which results from insulin malfunctioning. Zinc is essential for the production of insulin, a hormone and carbonic anhydrase, an enzyme in the body (Uruquiaga *et al*., 2000). Iron is a component of haemoglobin, a protein which is needed to transport oxygen in the blood. Iron together with haemoglobin and ferrodizin plays important role in man's metabolism.(Uruquiaga *et al*., 2000). Potassium and sodium are needed for proper functioning of the nervous system and other human defence mechanism.

The seeds of *Aframomum spp* contain alkaloids, flavonoids, saponins, tannins, and terpenoids. This is in conformity with the work of (Doherty *et al*., 2010) which reported that alkaloids rank as the most efficient therapeutically significant plant substance. In this study, *Aframomum melegueta* has the highest alkaloids, flavonoids and tannin which is line with Doherty *et al* (2010) and Chiejina and Udeh, (2012), that reported the presence of these constituents in *Aframomum melegueta*, whereas, the anthraquninones and proanthocyanindins concentration were higher in the *A. melegueta* and *A. danielli*. Phytochemicals have been reported to be responsible for plant bioactivity (Adedapo *et al.*, 2009).Alkaloids are reported to be useful in the body as muscle relaxant, which help to reduce the risk of diabetes and heart disease. Flavonoids biological function includes protection against allergies, inflammation and platelets aggregation. Tannis help fight diarrhoea, disable bacteria in the mouth and therefore prevent tooth decay and prevent cancer (Gbadamosi *et al*., 2011). Saponnin are reported to be useful in lowering cholesterol, helps the immune system fight against viruses and bacteria. Anthraquninoes are useful in breast cancer treatment, menopausal symptoms and gastrointestinal protection (Lieu *et al*., 2001). Knowledge of the phytochemical constituents of plants is desirable, not only for the discovery of therapeutic agents, but also because such information may be of value in disclosing new sources of economic materials such as alkaloids, tannins, oils, flavonoids, saponins, and essential oil precursors for the synthesis of complex chemical substances (Gbadamosi *et al*., 2011). The investigation of the phytochemical composition of the three species revealed that certain classes of active compounds were present. The seeds contain phytochemical which are of great pharmaceutical value and should be

exploited for health benefits and general socioeconomic development of our nation (Okoye *et al.*, 2013).

Based on the reported side effect of synthetic preservative, researches are documenting the use of natural preservative (Kim *et al*., 2007). In this present study there was a correlation between the antioxidant activity and the total phenolic content. The presence of phenolic compounds in the seed of *A. melegueta* which was the highest of the three species indicated that this plant might be used as an antifungal agent. This might be due to the fact that phenols and phenolic compounds have been extensively used in disinfectant and this remains the standard on which other bactericides are compared. Extracts from *A. melegueta* therefore have potent antiseptic or bactericidal properties (Okwu, 2004). The presence of phenol further indicated that the seed of this plant could act as anti-inflammatory, anti-clotting, antioxidant, immune enhancers and hormone modulators (Bravo, 1998).

Conclusion

The seeds of *Aframomum* have nutritional valves containing varying amounts of minerals such as calcium magnesium sodium, zinc, iron, phosphorus which when included to our diet could help in our body build up, in addition to its therapeutic and ethnomedicinal uses. The significant antioxidant composition of the seeds is an indication that it could be useful in the management of diseases due to oxidative stress and obesity. *Aframomum danielli* has been over exploited; there is a need to consider the other species as an alternatives to *Aframomum danielli* which could be used as herbal remedy and as a potential source for food and drugs.

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