NUTRITIONAL AND PHYTOCHEMICAL PROFILE OF COMMONLY CONSUMED SPICES IN NIGERIA

ABSTRACT

Background: Spices which are widely used in Nigeria have aroma, enhance taste of food and Possess medicinal values.

Objectives: This study aimed to determine the nutrients and phytochemical composition of selected spices commonly consumed in Nigeria

Materials and Method: Raw materials and other ingredients used for this study were purchased from ojaoba in Owo Local Government, Ondo State. The spices were analysed for proximate and mineral components using standard method as described by AOAC (2012). Sodium and potassium was determined using flame photometer and Calcium, selenium, copper, zinc, magnesium, and iron was determined using atomic absorption spectrophotometer.

Result: The proximate composition showed that protein was significantly ($p \leq 0.05$) high at 14.41% in Uziza seedand low at 11.60% in tumeric. Ginger contained high moisture content at 10.63%, while Uziza seed had the least value of 8.58%. High ash content was recorded in gingerat 5.27% and lowest at 3.70% in Uziza. For carbohydrate, Tumerichad the highest value of 65.57%, while Uzizahad the least value of 60.06%. Mineral compositionshowed high value of calcium in Uziza seed (402.03mg/100g). Nutmeg showed a high value of magnesium (13.3mg/100g) and turmeric indicated the highest value of potassium (405.43mg/100g), sodium (135.17mg/100g) for Uziza seed. The highest content of iron was recorded at 3.34mg/100g. Turmeric had a high value of zinc at 3.77 mg/100g and copper at 97 mg/100g, respectively. The spices contained an appreciable amount of phytochemicals. However, turmeric was significantly higher in alkaloids, flavonoids and polyphenols.

Conclusion: This study showed that spices have greater use in medicine and as a food supplement

Keywords: Spices, proximate, mineral composition

INTRODUCTION

Spices are edible portions of plant such as seeds, fruits, root, bark or vegetables substances that are used as culinary additives all over the world to season, flavor, and preserve dishes. Many spices are also regarded as therapeutic herbs in traditional medicine. Some are frequently used as a preservative to protect food from hazardous microorganisms or to prevent their growth (1,2). Humans since the beginning of life adopted the use of spices in a variety of ways throughout cultures and regions, including medicinal, religious ceremonies, cosmetics, and food (3,4). They have been found to play a vital role in health as food, partially as nutrient sources. Even while many spices, especially those produced from seeds, have significant fat, protein, and carbohydrate content by weight, they tend to add few calories to food Spices, on the other hand, can provide a significant amount of minerals and other micronutrients, such as iron, magnesium, calcium, and many more, to the diet when utilized in bigger quantities (5).Ginger (Zingiberofficinale) is a member of the Zingiberaceae family, and it is known as ginger and locally called Citta among the Hausa people of Northern Nigeria. Ginger is a perennial creeping plant that is widely used as a cooking spice, a common additive for food and beverages due to its flavour and pungency (6). It has a long history of cultivation and is said to have originated in China before spreading to India, South Asia, and Africa. In Nigeria, it is commonly cultivated within the middle belt states and is powder fastly becoming a household kitchen item in the country (7). Since prehistoric times, it has been used as a traditional medicine in many nations to cure a variety of ailments including stomach trouble, nausea, diarrhea, arthritis, and painful menstrual periods (8,9).

Nutmeg is the seed or ground spice of various species of the genus Myristicafragrans. Myristicafragrans (fragrant nutmeg or real nutmeg) is a dark-leaved evergreen tree farmed for two spices produced from its fruit: nutmeg and mace. Nutmeg is a spice prepared from the powdered seeds of the aromatic nutmeg tree (Myristicafragrans). The spice is used to flavour baked goods, confections, puddings, potatoes, meats, sausages, sauces, vegetables, and it has a characteristic pungent scent and a warm somewhat sweet taste (10). Uziza (Piperguineense) is locally known as Uziza among the Igbo, Iyere among the Yoruba, Etinkene among the Efik and Ibibio tribes, and Ebe-ahinhiakpoke among the Edo (11,2). Piper guineense leaves and seeds were first used in the southern portion of Nigeria, but consumption has since expanded throughout the country, including neighboring countries such as Benin Republic, Ghana, Liberia, and Cameroun.Piperguineense leaves are commonly used as leafy vegetables in most Nigeria soups while fruits are used as a flavour in most dishes (12). Alkaloids can be found in Uziza or Nigerian black pepper leaves. Alkaloids are recognized to have a therapeutically effective painkilling action. Therefore, using uziza leaves to treat pains including headaches, toothaches, and sore joints is a great idea. It can also be used to relieve menstruation pain. The leaves demonstrate a good pain-relieving effect. Furthermore, this natural component is completely harmless (13). Turmeric is a vivid orange-yellow spice that is widely used in curries and sauces. Turmeric is derived from the root of the turmeric plant. For thousands of years, the spice has been utilized for its medicinal, antioxidant, and anti-inflammatory effects (14). Turmeric's therapeutic characteristics may be able to help persons with immunological problems by boosting their immune systems (15).It's a powerful anti-inflammatory and antioxidant that may also aid with depression and arthritis problems (16).

MATERIALS AND METHOD

SOURCE OF MATERIALS

Ginger, turmeric, nutmeg, and uziza seed were purchased at Oja-Oba in Owo Local Government, Ondo State. All samples were obtained in a fresh state, viable free from disease.

SAMPLE PREPARATION FOR ANALYSIS

Preparation of Ginger, Turmeric, Garlic, and Nutmeg: All samples were obtained in fresh state, viable free from disease. It was selected and sorted i.e. removing the bad ones. The samples were washed, peeled, and also re-washed. Slicing, drying, pounding (mortar and pestle) and sieving were all done for the samples. Proper packaging was done for analysis

List 1: Packaging procedure

Ginger	Tumeric	Uziza	Nutmeg
↓	↓	↓	↓
Cleaning/sorting	Cleaning/sorting	Cleaning/sorting	Cleaning/sorting
↓	↓	↓	↓
Peeling	Peeling	Peeling	Peeling
↓	↓	↓	↓
Chipping/slicing	Chipping/slicing	Chipping/slicing	Chipping/slicing
↓	↓	↓	↓
Drying (at 60^0C for	Drying (at 60^0C for	Drying (at 60^0C for	Drying (at 60^0C for
↓	↓	↓	↓
12 hours)	12 hours)	12 hours)	12 hours)
↓	↓	↓	↓
Milling	Milling	Milling	Milling
↓	↓	↓	↓
Ginger powder	Turmeric powder	Uzizapowder	Nutmeg powder

Proximate Analysis

"The ash, protein, crude fibre, fat and moisture contents of the prepared spices were determined using the standard methods described" by AOAC (17). Total carbohydrate was calculated as the difference between 100 and the sum of the percentages of ash, protein, crude fibre, fat, and moisture.

Mineral Analysis and Vitamin Analysis

The mineral contents were determined in a dilute solution of the ashed samples according to the method outlined in AOAC (17) using Atomic Absorption Spectrophotometer (AAS) (210

VGP) for calcium, selenium, copper, magnesium, iron, and zinc, while potassium and sodium were determined using a flame photometer (please give the information of instrument as suggested previously for AAS). Water-soluble vitamins such as thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, and folic acid were determined using the AOAC (year?) (17).

Phytochemical Analysis

Determination of Flavonoid Content

The total flavonoid content was estimated using the procedure described by Zhichen*et al*. (18), a total of 1 ml of sample was diluted with 200µl of distilled water separately followed by the addition of 150 µl of sodium nitrate (5%) solution. "This mixture was incubated for 5 minutes and 15 µl of ammonium chloride (10%) solution was added and allowed to stand for 6 minutes. Then 2ml of Sodium hydroxide (4%) solution was added and made up to 5ml with distilled water. The mixture was shaken well and left for 15minutes at room temperature. The absorbance was measured at 510nm.The appearance of pink colour showed the presence of flavonoid content. The total flavonoid content was expressed as rutin equivalent on dry weight basis (mg RE/100g extract) using a standard curve". [53]

Determination of Total Phenol

The amount of total phenolic content was determined according to Xu and Chang (19) with slight modifications. "After adding Folin-Ciocalteu reagents and sodium carbonate to aliquots of samples, the mixtures were set in 400C water bath for 20 minutes. The absorbance was measured at 740nm using spectrophotometer and the total phenolic content was expressed as milligrams of gallicacid equivalents (GAE) per gram of defatted sample" [53]**.**

Determination of alkaloid content

The alkaloid content was determined using the gravimetric method of Harborne (20). The ground spice samples (5.0 g) were each dispersed in 50 ml of distilled water, 95 % methanol, acetone / hexane, n-hexane / methanol / acetone, and acetone / water / acetic acid solvents in 250 ml volumetric flasks. These were shaken vigorously and allowed to rest for 4 h before being filtered through What man no. 5 filter paper.

The filtrates were then evaporated to one-quarter (1/4) of the original volumes, after which concentrated ammonium hydroxide (NH_4OH) was added dropwise to each alkaloid until the precipitate persisted. The mixtures were then filtered through weighed filter paper, and the alkaloid residues were washed with 1 % ammonium hydroxide solution. The filter papers and contents (alkaloids) were oven-dried at 60 OC for 30 min. and reweighed to determine alkaloids contents using the expression,

Percentage (%) alkaloid = $\underline{W_2 - W_1}$ X 100

W

Where, W = weight of spice sample, W_1 = weight of empty filter paper,

W_2 = weight of filter paper plus alkaloid precipitated.

Determination of phytate content

Phytate content was determined according to the method of AOAC (17). The spice sample (4.0 g) was soaked in 100 ml of distilled water, 95 % methanol, acetone/water/acetic acid, acetone/hexane or hexane/methanol/acetone solvent for 3 h and then filtered through Whatman N0. 2 filter paper. The filtrates (25 ml) were pipetted into 50 ml conical flasks, and 5ml of 0.3% ammonium thiocyanate solution was added, after which 53.5 ml of distilled water was added and the mixtures were titrated against standard iron (iii) chloride solution containing 0.00195g Fe^{3+} / ml until a brownish yellow colour persists for 5min. The phytate content of the spices was expressed as a percentage (%) phytate in the spice sample.

Saponin content determination

Ground sample (1 g) of each spice was macerated in 10ml of distilled water, 95 % methanol, acetone/water/acetic acid, acetone/hexane or hexane/methanol/acetone; and the extract was decanted into a 50 ml beaker. The residue was re-extracted with another 10 ml of solvent, allowed to rest, and then decanted into the formal beaker. The extract was pooled together and evaporated to dryness, re-dissolved in 6ml of ethanol, and 2 ml of the ethanol extract was allowed to stand for 30 min for colour development. Absorbance was read at 550 nm and used to extrapolate saponin content from a standard curve.

STATISTICAL ANALYSIS

The result was expressed as mean ± standard deviation and the test for statistical significance was carried out using one-way analysis of variance (ANOVA). Significant means were separated using Duncan's New Multiple Range Test (DMRT) and differences were considered significant at $p \leq 0.05$.

RESULTS

Proximate composition of four traditional spices

Table 1 Proximate composition of four traditional spices.

Samples	Moisture	Ash	Fat	Fibre	Protein	Carbohydrate
A	10.48 ± 0.04^{b}	4.17 ± 0.01^{c}	3.82 ± 0.02^{d}	4.37 ± 0.05^{c}	11.60 ± 0.2^{d}	65.57 ± 0.09^{a}
B	10.63 ± 0.03^{a}	5.27 ± 0.04^{a}	4.51 ± 0.01^{c}	3.93 ± 0.03^{d}	13.13 ± 0.26^{b}	62.54 ± 0.10^{b}
C	10.48 ± 0.03^{c}	4.20 ± 0.01^{b}	5.82 ± 0.00^{b}	5.24 ± 0.02^{b}	12.76 ± 0.01^{c}	61.50 ± 0.05^{c}
D	8.58 ± 0.02^{d}	3.70 ± 0.01^{d}	6.09 ± 0.01^{a}	7.17 ± 0.05^{a}	14.41 ± 0.02^{a}	60.06 ± 0.08^{d}

Mean values with standard deviation. Values with the same superscript in the same columns are not significantly different at ($P \leq 0.05$). **Key:A**= Turmeric**, B** = Ginger**, C** = Nutmeg**, D** = Uziza seed

Table 1 shows the proximate composition of four traditional spices analysed; ginger, turmeric, nutmeg, and uziza seed.. Sample B (Ginger) had the highest value of moisture (10.63%) while sample D (Uziza seed) had the lowest value of 8.58%, however, there was no significant difference ($p \leq 0.05$) between sample A (Turmeric) and sample C (Nutmeg). Sample B had the highest ash content while sample D had the lowest ash content. In terms of fat content, sample D (6.09%) was significantly ($p \leq 0.05$) higher than sample A (3.82%), B (4.51%) and sample C (5.82%). For the fibre content, sample D had the highest value of 7.17%% while sample B had the lowest value of 3.93%, Sample D had the highest value of protein (14.41%). The table also showed the carbohydrate contents of the samples; Sample A (65.57%) was significantly ($p \leq 0.05$) higher than samples B, C, and D.

Mineral composition of four traditional spices

Table 2 Mineral composition of four traditional spices

Samples	Na	Ca	K	Zn	Cu
A	28.47 ± 0.058^{d}	181.67 ± 0.153^{c}	405.43 ± 0.321^{a}	3.77 ± 0.003^{a}	0.18 ± 0.002^{b}
B	35.57 ± 0.115^{c}	72.57 ± 0.058^{d}	374.47 ± 0.153^{b}	1.36 ± 0.031^{d}	0.30 ± 0.003^{a}
C	112.47 ± 0.058^{b}	327.77 ± 0.306^{b}	140.60 ± 0.100^{d}	3.19 ± 0.008^{b}	0.10 ± 0.006^{d}
D	135.17 ± 0.153^{a}	402.43 ± 0.0115^{a}	174.97 ± 0.208^{c}	2.78 ± 0.021^{c}	0.12 ± 0.002^{c}

Mean values with standard deviation. Values with the same superscript in the same columns are not significantly different at ($P \leq 0.05$).
Key: A = Turmeric, **B** = Ginger, **C** = Nutmeg, **D** = Uziza seed

Table 3 Mineral composition of four traditional spices.

Samples	Mg	Se	Fe
A	12.72 ± 0.026^{b}	0.02 ± 0.003^{d}	3.34 ± 0.071^{a}
B	10.70 ± 0.107^{d}	0.03 ± 0.002^{c}	2.28 ± 0.068^{b}
C	13.13 ± 0.029^{a}	0.22 ± 0.006^{b}	1.24 ± 0.005^{c}
D	10.82 ± 0.005^{c}	0.28 ± 0.005^{a}	0.79 ± 0.05^{d}

Mean values with standard deviation. Values with the same superscript in the same columns are not significantly different at ($P \leq 0.05$). **Key: A** = Turmeric, **B** = Ginger, **C** = Nutmeg, **D** = Uziza seed

Presented in Table 2 & 3 are the results obtained for the mineral composition of four traditional spices (turmeric, ginger, nutmeg, and uziza seed). The result shows that calcium and potassium were the predominant mineral elements ranging between 72.57-181.67 and 174.97- 405.43for calcium and potassium, respectively.Sample D (uziza seed) had the highest sodium content while sample A (turmeric) had the lowest sodium content. The copper content of sample A (0.18ppm), B

(0.30ppm), C (0.10ppm) and sample D (0.12ppm) were significantly different $p \leq 0.05$. Sample B (ginger) had the highest copper content while sample C (nutmeg) had the lowest copper content. For the magnesium content, sample C (nutmeg) had the highest value of 13.13ppm while sample B had the lowest value of 10.70ppm.

Table 4 Vitamin Composition of commonly consumed spices

VITAMINS (mg/100g)	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
B1 (thiamine)	0.27^{c} ± 0.0	0.30^{b}± 0.0	0.60^{a}± 0.0	0.21^{d}± 0.0
B2 (riboflavin)	0.29^{d}± 0.0	0.31^{c}± 0.0	0.89^{a}± 0.0	0.51^{b}± 0.0
B3 (niacin)	8.05^{b}± 0.0	8.48^{a}± 0.0	4.34^{c}± 0.0	2.90^{d}± 0.0
B5(Pantothenic acid)	0.97^{b}± 0.0	1.26^{a}± 0.0	0.56^{c}± 0.0	0.48^{d}± 0.0
B6 (pyridoxine)	50.01^{b}± 0.3	62.13^{a}± 0.1	32.46^{c}± 0.2	28.90^{d}± 0.4
B9 (folic acid)	106.76^{a}± 0.2	94.50^{b}± 0.2	74.66^{d}± 0.2	80.10^{c}± 0.1

Values of mean ± standard deviation triplicate sample $^{a-d}$ Mean with similar super script in each row are not significantly different ($P>0.05$)
KEY: Sample A- Tumeric, Sample B- Ginger, Sample C- nut Meg, Sample D- uziza seed

Table 4 shows the vitamin composition of vitamin composition of four traditional spices commonly consumed in Nigeria.The vitamin B_1 and vitamin B_2content was generally low in the samples. The result further shows that the samples were generally high in vitamin B_6 (Pyridoxine) and B_9 content. Sample A was significantly higher in B_9followed by sample B (94.50 mg/100 g) and D (80.10 mg/100 g) respectively.

Table 5phytochemical properties of spices commonly consumed in Nigeria.

Sample	Alkaloid	Polyphenol	Saponin	Flavonoid	Phytate
A(aq)	52.15±0.00^{c}	18.29 ± 0.01^{d}	0.34 ± 0.00^{a}	6.86 ± 1.72^{a}	1.37 ± 0.02^{a}
m)	60.32±0.04^{a}	25.08 ± 0.02^{a}	0.28 ± 0.00^{b}	6.15 ± 0.03^{b}	0.74 ± 0.05^{e}
B(aq)	40.70±0.10^{g}	10.48 ± 0.02^{h}	0.22 ± 0.00^{d}	4.64 ± 0.02^{c}	0.65 ± 0.01^{f}
B(m)	48.19±0.01^{e}	20.36 ± 0.11^{c}	0.20 ± 0.00^{e}	4.88 ± 0.02^{c}	0.58 ± 0.01^{g}
C(aq)	34.96±2.32^{h}	14.73 ± 0.00^{g}	0.19 ± 0.00^{f}	3.29 ± 0.01^{d}	0.87 ± 0.00^{d}
C(m)	43.16±0.01^{f}	15.61 ± 0.00^{f}	0.24 ± 0.00^{c}	3.84 ± 0.01^{d}	0.91 ± 0.00^{c}
D(aq)	50.25±0.03^{d}	17.36 ± 0.01^{e}	0.14 ± 0.00^{h}	4.24 ± 0.01^{cd}	0.97 ± 0.00^{b}
D(m)	57.58±0.00^{b}	24.11 ± 0.01^{b}	0.18 ± 0.00^{g}	4.51 ± 0.00^{c}	0.94 ± 0.00^{bc}

Values of Mean ± Standard deviation of triplicate sample a-h. Mean with similar super script in each column are not significantly different ($P>0.05$)
Key: Sample A(aq) – aqueous Tumeric ,Sample A(m) – water Tumeric, Sample B(aq) – aqueous Ginger, Sample B(m) – water ginger, Sample C(aq) – aqueous Nut Meg
Sample C(m) – water Nut Meg, Sample D(aq) – aqueous Uziza seed, Sample D(m)- water Uziza seed

Table 5 shows the phytochemical properties of spices commonly consumed in Nigeria. Sample A (turmeric) is significantly ($P>0.05$) higher in alkaloids,polyphenol, and flavonoid.While the values recorded saponin was generally low. It ranged from 0.34 in sample A (aq) to 0.14 unit?? in sample D (aq) and 0.28 unit? in sample A (m) to 0.18in sample D (m) The table also revealed that sample A (qq) has the highest (0.355mg/100g) saponin content while sample D (qq) has the least (0.120mg/100g) saponin content.

DISCUSSION

spices are generally used for flavour, preservatives, and therapeutic purposes. Hence this study analysed the nutrients and phytochemical properties of some selected spices commonly used in Nigeria. The moisture contents of the samples ranged from 8.58% - 10.63%. These values were in similar agreement (9.12% - 11.55%) with Ojinnaka*et al.*,(21)on Comparative Study on the Nutrient and Antinutrient Composition of the Seeds and Leaves of *Uziza (Piper Guineense)*. The moisture content of any food has been noted to be one of the major indicators that influence the shelf stability of foods. Food samples with low moisture contents indicate low water activity which means moisture will not be available for microorganisms which are the principal agents of spoilage (22). The crude fat ranged between 3.82% and 6.09%. According to this study, uziza seed had the highest value (6.09%)while turmeric had the lowestvalue (3.82%) of fat content. The decrease in fat content of turmeric could be due to insufficient lipid concentration in fruits. Nwofia*et al.*, (23) have earlier reported that low lipid concentration in fruits indicates that the lipids are mobilized and stored in the seeds thereby making it a good source for people suffering from obesity. These values were comparable to values reported for traditional spice (15,24). Dietary fat has been shown to be very important in the absorption of and retention of flavour thus enhancing palatability (24,25). The ash content ranged between 3.70% and 5.27%. Ginger had the highest ash content, the ash values obtained for Turmeric (curcumin) and Nutmeg (*Myristicafragnans*) were similar to 4.33% reported by Nita and Aradhita (4) on black cumin seed used as a spice. The ash content indicates the amount of mineral composition present in food and high ash content is an indication of high inorganic mineral content (26).

The fibre content in this study (3.93-7.17 mg/kg) was similar to the range 5.36 -6.42mg/kg reported by Udenevwo (27). The crude fiber of the sample D (uziza seed) was evidently higher (7.17%) than that of the other samples. This value compares well with 7.33unit reported by Nita and Aradhita (4). Agostoni*et al.* (28) "reported that non-starchy crops are the richest sources of dietary fiber. Crude fiber is the part of food that remain undigested by human large intestine but the normal functioning of the intestinal tract depends upon the presence of adequate fiber". It is helpful in the management of non-communicable diseases like obesity, cancer, hypertension, and other NCDs because it increases stool bulk and shortens the time waste materials spend in the digestive tract (29).

The protein content of the samples ranged from 11.60%-14.41% were similar with 8.91% – 13.57% reported by Onimawo et al., (30). Protein has been proved to be an essential component for both human and animal survival, as well as being required for the synthesis of the structural elements of the human body, such as the muscles and organs(31).

The finding shows that carbohydrate contents ranges from 61.50%-65.57% with a significant difference ($p \leq 0.05$). This is higher compared to the findings of Ameh*et al.*,(32) who reported 6.31% to 33.79% on the Survey for the composition of some common spices cultivated in Nigeria. Carbohydrates are the most abundant biological molecules and play important roles as sources of energy to the body, brain, heart, nervous, digestive function, and immune system(22). The results of this study indicate that the spices possess moderate amounts of carbohydrates and these can provide accessible fuel (energy) for physical performance and regulate nerve tissues.

The sodium content of the samples ranged from 28.47ppm - 135.17ppm. The report of this finding showed that regular consumption of ginger (35.57ppm) especially turmeric (28.47) which is low in sodium could help to prevent hypertension. This result agrees with the findings of Dahl, (33) who reported that low sodium content of these spices could be an advantage because of the direct relationship between sodium intake and hypertension in human beings.

In this study, it was found that calcium (402.43ppm) content of Uziza seed was significantly ($p \leq 0.05$) higher than the rest of the samples. A balanced proportion of calcium is needed in the body. Calcium is an essential mineral component in the body which helps in regulating muscular contractions, strong teeth formation also development of strong bones and is needed for the prevention of osteoporosis, arthritis, rickets and tooth decay (31).

The selenium content of the samples ranged from 0.02-0.28ppm. Sample D (uziza seed) had the highest value (0.28ppm) while sample A (turmeric) had the least value (0.02ppm). These values are low compared to 5.8 - 23.0 reported by Sirichakwal*et al.*, (34) on the selenium content of Thai Foods and 0.254-0.505 reported by (35). Selenium is an important trace element that helps in the synthesis of various Selenium- containing proteins and also has other relevant biological usefulness as well as playing important role in the human diet due to its ability to act as a preventive agent against some health challenges (36, 37). The low level of Se in foods has been ascribed to the low soil content of selenium, such as in volcanic regions (38).

The iron content of the four spices ranged from 0.79ppm-3.34ppm. These values were higher than the values recorded by Ameh et al. (32). Iron content in Turmeric (3.34ppm) was significantly ($p \leq 0.05$) higher compared to Nutmeg (1.24ppm). Iron is an essential trace element that forms an integral part of many proteins and enzymes which plays an important role in the human body in maintaining good health, control of infection, and cell immunity. (39).

Potassium content was relatively high in all cases except in two samples (Nutmeg, 140.60ppm and Uziza seed, 174.97ppm). The highest value was observed for Turmeric with an average value of 405ppm.This is the most abundant of the entire elements determined in these samples. Potassium functions in the body to regulate processes such as nerve transmission, muscle contraction and control fluid balance and enhances the metabolism of protein and carbohydrate (40,41).

The zinc contents of the four samples ranged from 1.36ppm-3.77ppm. These were significantly higher when compared with the Recommended Dietary Allowance (RDA) (42).however the values observed in this study were significantly lower than the values reported by Ameh et al. (32) in their study for spices. Findings from this study indicate that turmeric has the highest value of zinc. Zinc is very essential for growth, protein synthesis, immunity, and sexual functions. Consumption of food items that are rich in Zinc will help in combating malnutrition and parasitic illnesses like malaria (43).

"Minerals are an important part of a healthy diet. Nutrition professionals recommend that they be consumed as part of a balanced diet, primarily as fruits and vegetables" (44). "The result of the mineral composition of this study has collaborated with several other works that reported the presence of mineral elements such as calcium, iron, potassium, phosphorus, sodium, magnesium, copper, and zinc in spices which are very important to human nutrition" (45, 4,27).

The vitamin B1 and B2 content of these spices was generally lower than those reported by (46,47). Thiamine plays an active role in the oxidative decarboxylation of pyruvic acid thus reducing the accumulation of pyruvic acid and its reduction product latic acid in the tissue which in turns reduce the occurrence of muscular weakness(47). "Sample B (ginger) is highly rich in B-complex vitamins more than turmeric, nutmeg and uziza seed, its inclusion in diet could be good source of anti-oxidants and enough vitamins for formation of enzymes that are essential for optimum health" (48). Vitamin B5 varies from (0.48 ± 0.0) in sample D to

(1.26± 0.0) in sample B with sample B showing the highest value in quality of vitamin B5with their significant difference (p>0.05). Pantothenic acid is important for the production of energy, hormone synthesis and the metabolism of fat, protein and carbohydrates (49). The spices were generally high in vitamin B_9. Inclusion of these spices in diet helps in the promotion of red blood cell formation and maturation, it also lowersneural tube birth defects, and helps to control homocysteine levels, thus potentially reducing the risk of coronary heart disease (49).

Phytochemicals exhibit great antioxidant potential and produce beneficial effects to human health (50). The spices in this study contain quite an appreciable quantity of different phytochemicals in varying amounts, each of these phytochemicals is famous for various protective and advantageous properties. Turmeric (sample A) was significantly higher in alkaloids, polyphenols, and flavonoids compared to others. Flavonoids and alkaloids as well as their synthetic derivatives are used as medicinal agents as analgesic, antimalarial, antiseptic, antioxidant antitumor anticancer,and bactericidal (51,52). In general the presence of these phytochemicals in spicesin this studycould be responsible for their much-acclaimed medicinal uses in various disease conditions such as atherosclerosis, arthritis, nausea, asthma, worm expeller, bacterial infections, and cancer.

CONCLUSION

This study showed that the spices contained high content of crude protein with low fat content and crude fibre. The low moisture content indicates good quality and its prolonged shelf life especially in Uziza seed. The spices are good sources of carbohydrate, thus contributes to the energy generation for cellular activities. The ash contents suggest that they are good sources of minerals. The spices contained appreciable amounts of valuable nutrients however Uziza contained more fat, fibre, and protein than the rest of the spices.

The spices also contained quite an appreciable amount of various minerals and phytochemicals. The result suggest that the spices if use judiciously in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases.

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