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NUTRITIONAL AND ANTINUTRITIONAL COMPOSITION OF SOME SPICES USED AS FOOD CONDIMENTS IN AKURE, SOUTHWEST NIGERIA

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ABSTRACT

Spices are usually employed as a flavourant in food but may also found applications in ethnomedicine, perfumery, colourant, tenderizers amongst others. This study is aimed at investigating the nutritional and antinutritional properties of eight spices that are commonly consumed in Akure, Nigeria because of increase in their consumptions. Samples of the spices were purchased in the open Oja Oba market in Akure, processed and analyzed for proximate, antioxidant and antinutrient compositions using standard procedures. Results of proximate analysis shows *Tamarindus indica* to have the highest moisture content of 28.40% while lowest (8.6%) being *Monodora myristica, Piper guineense* has the highest ash content of 37% while both *Tamarindus indica* and *Aframomum melegueta* have the least value of ash content of 2.5%. The carbohydrate content obtained were in the order of *Aframomum melegueta* (61.13%)>*Syzygium aromaticum* (54.10%)>*Tamarandus tetrapetra* (50.01%)>*Ocimum gratissimum* (44.59%) and therefore could be a source of energy. The following spices G. *latifolium*, M. *myristica* and A. *melegueta* have the highest values of 15.75%, 38.40%, 7.41% for protein, fat and fibre respectively. The highest and lowest values of tannin and saponin were found in *Tamarandus indica* and *Gongronema latifolium* while for alkaloids, it is *Ocimum gratissimum* and *Piper guinensis*. The antioxidant contents reveals that β-carotene, lycopene and anthocyanin are respectively prominent antioxidants found in *Gongronema latifolium* (18.31 mg/g), *Syzygium aromaticum* (5.15 mg/g) and *Gongronema latifolium* (2.17 mg/g). The study revealed spices as potential contributor to health needs of consumers with considerable antioxidant properties and of minimal antinutritional concern.

Keywords: spices, nutritional, antinutritional, antioxidant, health benefit, nutritive value

INTRODUCTION

Plant materials form a major fraction of our diet and their nutritive value is important in determining the growth and developments of all human beings (FAO, 2020) and may therefore help improve the effects of nutrient deficiencies. According to Ekor, (2014), about 80% of the population in developing countries depends almost totally on herbal medicine for their basic healthcare needs. Plants naturally produce and hoard secondary metabolites like phenols, alkaloids, steroids, terpenoids, flavonoids, saponins, glycosides, and tannins that fight disease and have been shown to have therapeutic effects because of their antioxidant, antimicrobial, antidiabetic, anti-inflammatory and chemoprotective properties (Fredotovic *et al*, 2021). Spices, in different forms, are frequently utilized as medicines due to their accessibility, effectiveness and cost (Sachan *et al* 2018). Increasing demand for nutritional and healthy foods with better nutraceutical, pharmaceutical, nutritional and functional properties requires food composition study of which proximate analysis plays a crucial role (Finglas *et al*, 2017).

Proximate composition, as they are sometimes referred to, include carbohydrates, fats and proteins that form the major portion of the diet, while minerals and vitamins form comparatively a smaller part (Etonihu *et al*, 2013). Concentrations of various nutrients in food such as proteins, fat, carbohydrate, vitamins and minerals determine the quality of food. Proximate analysis in plants gives valuable information on moisture content, ash content, volatile matter, carbohydrates, fats and proteins etc. and help to access the quality of the sample (Thomas and Krishnakumar, 2015). Herbs and spices have been used for several purposes since ancient times. The specific uses of spices tend to vary considerably among cultures and countries as medicine, religious rituals, cosmetics, perfumery and foods. As food, they have been shown to play an important role in health partially as sources of nutrients (Ahongshangbam and Shantibala, 2017). Spices could provide dietary supplements and some component may promote bowel regularity and enhance frequent waste elimination, including bile (Saldanha *et al*, 2016). Fiber has a physiological effect on the gastrointestinal function of promoting the reduction of tracolonic pressure which is beneficial in diverticular disease. Fiber also has a biochemical effect on the absorption and re-absorption of bile acids and consequently the absorption of dietary fats and cholesterol (Saldanha *et al*, 2016).

Spices have been previously reported for their potential sources of carbohydrates, lipids, proteins and minerals, however, they were limited in terms of regionalization, types and varieties of spices studied as well as specific food compositions investigated (Dingsten *et al*, 2020; Adegbite *et al*, 2021). The current investigation therefore seek to evaluate proximate composition and quantify some specific antioxidants contents generally regarded as index of nutrition as well as quantitatively estimate the anti-nutritional components (phytates, oxalates, polyphenols, tannins and alkaloids) of eight different spices commonly used as food condiment in Akure metropolis, Nigeria. This will provide dietary information for those who eat these spices with respect to nutrition and health.

MATERIALS AND METHODS

Samples and sample preparation

The samples of *Aframomum melegueta, Piper guineense, Monodora myristica, Tamarindus indica, Ocimum*

gratissimum, *Tetrapleura tetraptera*, *Gongronema latifolium* and *Syzygium aromaticum* were purchased in the popular Oja Oba market in Akure, Ondo State, Nigeria. Kept in a clean wrapper, properly labeled and taken to the herbarium section of the Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Nigeria for identification (the certificate were kept with the herbarium). Further processing of samples were done in Food Chemistry Research Laboratory of Federal University of Technology Akure where they were air-dried, ground using electronic grinder machine (Mallex SR NO CK 476) and stored in a polyethylene bottles with proper labels until analysis.

Nutritional composition of spices

Determination of proximate composition of spices

*Estimation of moisture***:** Two gram of each sample was taken in a flat-bottom dish and kept overnight in an air oven at 110-110°C and weighed. The loss in the weight was regarded as the measure of moisture content. *Estimation of ash*: Two gram each of the samples was weighed in a silica crucible and heated in muffle furnace for about 5-6 h at 500°C. The crucible was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. The process was repeated till the weight became constant. The final weight gave the ash content of the samples. *Estimation of crude fibre:* 1 g each of moisture and fat free material of each sample was treated with 100ml of 0.255±.005 N H_2SO_4 and the mixture was boiled for 30 min. After filtration and washing, the residue was treated and boiled with 100ml of 0.313±0.005N NaOH solution. The filtrate was washed with hot H_2SO_4, water and alcohol. The residue was ignited and the ash weighed. Loss in weight gave the weight of the crude fibre. *Estimation of crude protein:* The crude protein was determined following micro Kjeldahl method. The total protein was calculated by multiplying the evaluated nitrogen by a constant value of 6.253. *Estimation of crude Fat:* Two gram each of moisture free samples was extracted with petroleum ether (60-80°C) in a Soxhlet apparatus for about 6-8 h. The extract was then evaporated in a pre-weighed beaker. The increased in the weight of the beaker gave the crude fat content of the samples**.** *Estimation of total carbohydrate*: The percentage of carbohydrate was calculated using the formula: 100-(percentage of ash + percentage of moisture + percentage of fat + percentage of protein) (Ahongshangbam and Devi, 2017).

Determination of antioxidants contents of spices

Determination of β-carotene content: Into a conical flask containing 50 ml of 95% ethanol, 10g of the ground sample was placed and maintained at a temperature of 80 ^oC in a water bath for 20 minutes with periodic shaking. The supernatant was decanted, allowed to cool and its volume measured by means of a measuring cylinder and recorded as initial volume. The ethanol concentration of the mixture was brought to 85% by adding 15ml of distilled water and it was further cooled in a container of ice water for about 5 minutes. The mixture was transferred into a separating funnel and 25ml of petroleum ether (pet-ether) was added. The funnel was swirled gently to obtain a homogenous mixture and it was later allowed to stand until two separate layers were obtained. The bottom layer was run off into a beaker while the top layer was collected into a 250 ml conical flask. The bottom layer was transferred into the funnel and re-extracted with 10 ml pet-ether for 5-6 times until the extract became fairly yellow. The entire pet-ether was collected into 250 ml conical flask and transferred into separating funnel for re-extraction with 50 ml of 80 % ethanol. The final final volume of extract was measured and its absorbance determined using a spectrophotometer (Model 6305 Jenway, Barlo world Scientific, Dunmow, United Kingdom) at a wavelength of 436nm (Mustapha and Babura, 2009). The concentration of β-carotene was calculated by the equation (deCarvalho *et al.*, 2012):

$$\beta - \text{Carotene Content } (\mu g/g) = \frac{A\ x\ V(ml)\ x\ 10^4}{A_{1cm}^{1\%}\ x\ P(g)}$$

where A = Absorbance; V = Total extract volume; P = sample weight; $A_{1cm}^{1\%}$ = 2592 (β-carotene Extinction Coefficient in petroleum ether).

Determination of total anthocyanin content: The total anthocyanin content was determined by method described by Taghavi *et al*., (2021) and simply by adding 15 ml of extracting solution (95% methanol, conc. HCl and water (80:1:20) to 5-g macerated sample, wrapped with aluminium foil and kept at 4 ^oC for 48hr with occasional shaking. At the end of the incubation period, the homogenates were centrifuged at 4°C, 8500 rpm for 15 min. The supernatant was then removed and the absorbance of anthocyanin was measured immediately by the UV-Visible spectrophotometer (Model 6305 Jenway, Barlo world Scientific, Dunmow, United Kingdom) at 530 and 657 nm. Anthocyanin contents of the spices were determined by the following formula:

$$\text{Total Anthocyanin Content } (\mu g/g) = \frac{A530 - 0.3A657\ x\ V(ml)}{M(g)}$$

A = absorbance at 530 and 657 nm, V = volume of extract (ml), and M = fresh mass of the sample (g).

Determination of lutein content: This was undertaken by method described by Rajashree *et al.,* (2013) and briefly as 10 g samples were grinded with a mortar and pestle and then added to 40 ml of acetone in a beaker and the solution filtered using Whatman No. 1 filter paper. The filtrate was centrifuged at 10,000 rpm for 10 minutes. The aqueous phase was collected and stored at 4˚C overnight and the absorbance was measured using spectrophotometer (Model 6305 Jenway, Barlo world Scientific, Dunmow, United Kingdom) at a wavelength of 446 nm. Concentration of lutein was calculated using the following formula:

$$\text{Lutein Content } (\mu g/g) = \frac{A\ x\ V(ml)}{A_{1cm}^{1\%}\ x\ P(g)}$$

where A = Absorbance; V = Total extract volume; P = sample weight; $A_{1cm}^{1\%}$ = 2589 (Absorption Coefficient)

*Determination of lycopene content***:** 5 g macerated sample was transferred into 100 cm^3 amber screw capped vial and 50 cm^3 hexane-acetone-ethanol mixture (2:1:1 v/v/v) was added and the mixture shaken for 15 min on an rotary orbital shaker (250 rpm, NSW 200) for extraction to take place. Thereafter, 3 cm^3 of distilled water was added and the sample was shaken for another 5 mins. The vial was allowed to stand for 5 min to enable phase separation and the upper layer (hexane) was then collected into an amber screw capped vial. The absorbance of the upper, hexane layer was measured in a 1 cm path length quartz cuvette at 503 nm against the solvent-blank (hexane) using UV/Visible spectrophotometer (Model 6305 Jenway, Barlo world Scientific, Dunmow, United Kingdom). The lycopene content of each sample was then estimated using the absorbance at 503 nm and the sample weight (Davis *et al.*, 2003).

Antinutritional composition of spices

Determination of oxalates content: 2.50 g of each sample was added to 20 cm^3 of 0.3 M HCl and the mixture extracted by warming at a temperature of 50 ^oC for 1 hour with constant stirring using a magnetic stirrer. 1.0 cm^3 of 5 M ammonium hydroxide was added to 5.0 cm^3 aliquot of extract to ensure

alkalinity, this is followed by addition of 2 drops of phenolphthalein indicator, 3 drops of glacial acetic acid and 1.0 cm^3 of 5% calcium chloride to make the mixture acidic and allowed to stand for 3 hours. The mixture was thereafter by centrifuged at 3000 rpm for 15 minutes. After discarding the supernatant, the precipitate was washed using hot water by mixing thoroughly and centrifuging after each washing. Then, 2.0 cm^3 of 3 M tetraoxosulphate (VI) acid was added and the precipitate dissolved by warming in a water bath at 70 ^oC. Freshly prepared 0.01 M potassium permanganate ($KMnO_4$) was used to titrate the content of each tube at room temperature until the first pink colour appears throughout the solution. The solution was allowed to stand until it returned colourless, after which it was warmed on an electric hot plate at 70 ^oC for 3 minutes, and re-titrated again until a pink colour appears and persists for at least 30 seconds. Oxalate in the sample was calculated as follows (Ezeonu and Ejikeme, 2016):

$$C_2O_2^{4-} + 8H^+ + MnO_2^{4-} \rightarrow 2CO_2 + 4H_2O + Mn^{2+}$$

$$Ratio\ of\ reacting\ ions = 1:1$$

$$From\ M_1V_1 = M_2V_2$$

$$where\ M_1\ is\ molarity\ of\ KMnO_4,$$

$$M_2\ is\ molarity\ of\ extract\ (oxalate),$$

$$V_1\ is\ volume\ of\ extract\ (oxalate), and$$

$$V_2\ is\ volume\ of\ KMnO_4\ (Titre\ Value).$$

$$Molecular\ Weight\ of\ CaCO_3 = 100$$

$$Weight\ of\ oxalate\ in\ titre =$$

$$M_2 \times molecular\ weight = Xg$$

$$Weight\ of\ oxalate\ in\ titrand\ 2\ cm^3 = \frac{Xg}{1000} \times 2 = Y$$

$$100\ cm^3\ of\ oxalate\ extract\ will\ contain$$

$$= \frac{Y}{2.5} \times 100\ g = W$$

$$\%\ oxalate\ content\ (g/100\ g) = \frac{W}{2.5} \times 100$$

Determination of tannins content: Aqueous methanol 80 % was used to extract the tannin compounds in the ratio of 1:10 (dry weight: volume) for 60 min at 90 ^oC. The homogenate was filtered using vacuum evaporator and the filtrates centrifuged at 19000 rpm for 5 min at 4 ^oC. The tannin content of this filtrate was determined using Folin-Ciocalteu assay. 0.1 ml aliquot of extract was added to 0.75 ml of distilled water followed by 0.5 ml Folin-Ciocateu reagent and then 1 ml of 35 % sodium carbonate (Na_2CO_3). The mixture was shaken vigorously after diluting to 10 ml with distilled water. The mixture was incubated for 30 min at room temperature and the absorbance read at 725 nm using UV-Vis spectrophotometer (Model 6305 Jenway, Barlo world Scientific, Dunmow, United Kingdom). Distilled water was used as blank. 1 g of Gallic acid was dissolved in 100 ml of methanol to get 1% solution of Gallic acid (10 mg/ml). A standard gallic acid curve was constructed by preparing the dilutions of (0.1, 0.5, 1.0, 2.5 and 5 mg/ml) in methanol from standard solution of gallic acid. 0.1 ml of each of these dilutions were mixed with 0.5 ml of water and then with 0.1 ml of Folin-Ciocalteu reagent and allowed to stand for 6 minutes. Then 1 ml of 35 % sodium carbonate and 0.5 ml of distilled water was added to the reaction mixture. The absorbance was recorded after 30 minutes at 725 nm and plotted as calibration curve. The total tannins content was expressed as GAE/ g dry matter, as calculated from the prepared standard curve with (Mohammed and Abd-Manan, 2015).

Determination of alkaloids content: The alkaloid content was determined gravimetrically. Briefly, 5 g of each sample was weighed using a weighing balance and dispersed into 50 ml of 10 % acetic acid solution in ethanol. The mixture was well shaken and then allowed to stand for about 4 h before it is filtered. The filtrate was then evaporated to one quarter of its original volume on hot plate. Concentrated ammonium hydroxide was added drop wise in order to precipitate the alkaloids. A pre-weighed filter paper was used to filter off the precipitate and it was then washed with 1 % ammonium hydroxide solution. The filter paper containing the precipitate was dried in an oven at 60 ^oC for 30 min, transferred into desiccators to cool and then reweighed until a constant weight was obtained. The constant weight was recorded. The weight of the alkaloid was determined by weight difference of the filter paper and expressed as a percentage of the sample weight analyzed. The experiment was repeated thrice for each sample and the reading recorded as the average of three replicates (Adeniyi *et al*., 2009).

$$\%\ Alkaloid = \frac{Weight\ of\ alkaloid}{Weight\ of\ sample} \times 100$$

Determination of saponins content: Exactly 100 cm^3 of 20 % aqueous ethanol was added to 5 g of each sample in a 250 cm^3 conical flask. The mixture was heated over a hot water bath for 4 hours with continuous stirring at a temperature of 55 ^oC and filtered. The residue was re-extracted with another 100 cm^3 of 20 % aqueous ethanol, heated for 4 hours at a constant temperature of 55 ^oC with constant stirring and again filtered. The combined extracts were evaporated to 40 cm^3 over water bath at 90 ^oC and transferred to a 250 cm^3 separating funnel. 20 cm^3 of diethyl ether was added to the concentrate in a 250 cm^3 separating funnel and vigorously agitated from which the aqueous layer was recovered while the ether layer discarded. This purification process was repeated twice. 60 cm^3 of n-butanol was added and extracted twice with 10 cm^3 of 5 % sodium chloride. After discarding the sodium chloride layer the remaining solution was heated in a water bath for 30 minutes, after which the solution was transferred into a crucible and was dried in an oven to a constant weight. The saponin content was calculated as a percentage (Ezeonu and Ejikeme, 2016):

$$\%\ Saponin = \frac{Weight\ of\ saponin}{Weight\ of\ sample} \times 100$$

RESULTS AND DISCUSSION

Nutritional Composition of Selected Spices

Proximate Composition

Fruits and vegetables comprise of the essential part of human diet as they are major source of dietary nutrient of great importance supplying dietary fibre, vitamins, minerals and phytochemicals that serve as antioxidants, phytoestrogens, anti-inflammatory agents etc. They are universally recommended for their health promoting properties and diets rich in them have been associated with several health benefits (Boa *et al*., 2015, Finglas *et al,* 2017, Fredotovic *et al,* 2021). The nutritional composition (proximate and antioxidant composition) of the selected spices that are commonly used as soup and food conditioner in Akure is shown in Table 1. The moisture content gives the amount of water present in a sample at a given time and it is an indication of freshness, longevity and shelf life. The moisture content in the selected spices ranges from *Tamarindus indica* (28.40%) to *Monodora myristica* (8.60%). The result indicates that *Monodora myristica* can be stored for long compared to the remaining samples. The presence of high moisture in a food sample indicates that there will be high rate to microbial activity which in turn leads to spoilage and hence implies low shelf-life. Ash content of a food sample is an indication of the amount of minerals present. High value of ash content indicates the presence of high inorganic composition which in

turns implies high mineral content. *Piper guineense has the highest (*37%) value while *Monodora myristica* and *Aframomum melegueta* are having the least 2.5% value indicating that *Piper guineense* may be a good source of minerals. The crud**e** fiber comprises of various components of food that are indigestible such as cellulose, pentosans, lignin etc. They help reduce low density lipoprotein cholesterol in the blood by binding with bile acids. Also help to eliminate waste from gastrointestinal tract because of their ability to bind water and this soften the stool. The crude fiber content is highest in *Syzygium aromaticum* (7.41%) and lowest is in *Monodora myristica* (3.29 %). The results reveal that *Syzygium aromaticum* and *Gongronema latifolium* are good sources of dietary fibre. Food with high fiber content guarantees a better healthy system because it helps lower blood cholesterol, keep weight under control, stabilizing glucose against diabetes. The amount of protein present in food samples is a function of abundance of nitrogen present and serves as an essential source of nutrition. The protein contents of *Gongronema latifolium* (15.75 %) was the highest and the least being *Syzygium aromaticum* (3.50%). The fat content of a food sample is a measure of resistance to rancidity which often leads to spoilage and wastage of food due to its undesirable colour and odour effect. *Monodora myristica* has the highest fat content (38.40%) while *Aframomum melegueta recorded the lowest value* (9.27 %). The carbohydrate content of a food sample helps to provide information about energy content and it serves as an essential source of energy to all cells in the body. The results from this work indicated that *Aframomum melegueta* has the highest carbohydrate content of 61.13 % while *Piper guineese* has the least value (15.84 %). This result obtained for all selected spices generally indicated them to be a potential carbohydrate source and can be used to fortify animal feeds. The proximate composition reported here is not very close to those reported in literatures, this observation is also true for most reported values among the literature found and cited. The value reported in this study is in-between those reported by Onimowo *et al.,* (2017) and those of Ogunka-Nnoka and Mepba (2008) but higher than those from Cameroon (Bouba *et al.*, 2017) and India (Ahongshangbam and Devi, 2017).

Antioxidant content of the spices

Antioxidants derived from herbal raw materials are found to be significant recently because of their health-promoting properties in the prevention of chronic non-communicable diseases. Antioxidant compounds contained in herbs have following effects: anti-inflammation, antibacterial, antifungal, antiviral and immune-stimulation effects (Fredotovic *et al*, 2021). The antioxidant content of the eight spice samples were evaluated under the following parameters - beta carotene, lycopene, lutein and anthocyanin as presented in Table 1. The beta carotene content as analysed in the selected eight different spices shows that *Gongronema latifolium* and *Syzygium aromaticum* have the highest level of beta carotene (18.31 and 15.50 mg/g respectively) while the *Piper guineense* and *Tetrapleura tetraptera* are having the least value of 1.24 and 1.02 mg/g respectively compared to the rest of the sampled spices. The anthocyanin content is highest (2.17 mg/g) in *Gongronema latifolium* and lowest (0.25 mg/g and 0.28 mg/g) in *Tetrapleura tetraptera and Piper guineense* respectively. The lutein content ranges between 0.11 – 1.11 mg/g for all spices analysed with the highest being in *Gongronema latifolium* (1.11 mg/g) and *Syzygium aromaticum* (1.01 mg/g). The lycopene content showed that *Gongronema latifolium* has the highest value of 5.15 mg/g followed by *Syzygium aromaticum* (5.12 mg/g) while *Tetrapleura tetraptera* (0.19 mg/g) and *Piper guineense* (0.0.23 mg/g) are the least. The result emphasizes the use of the spices as good sources of antioxidants which could serve as good health supplement most especially for *Gongronema latifolium* and *Syzygium aromaticum* because they are high dense in most of the analyzed antioxidants.

Table 1: Nutritional Composition of the Selected Spices

	Proximate Composition						**Antioxidants Composition**			
	Moisture	**Ash**	**Crude Fiber**	**Protein**	**Fat**	**Carbohydrate**	**Beta carotene**	**Antho-cyanin**	**Lutein**	**Lycopene**
	%	**%**	**%**	**%**	**%**	**%**	**mg/g**	**mg/g**	**mg/g**	**mg/g**
Monodora myristica	8.60±0.47	2.50±0.05	3.29±0.05	11.37±0.05	38.40±0.01	36.34±0.01	3.69±0.11	0.44±0.03	0.26 ±0.02	1.04 ± 0.03
Piper guineense	14.00±0.61	37.0±0.00	5.21±0.09	12.25±0.01	15.70±0.05	15.84±0.02	1.24±0.10	0.28±0.03	0.11±0.02	0.23 ±0.03
Aframomum melegueta	16.40±0.60	2.50±0.04	7.41±0.04	3.70±0.05	9.27±0.21	61.13±0.05	4.49±0.15	0.64±0.03	0.51±0.02	2.42 ± 0.03
Syzygium aromaticum	16.00±0.04	5.76±0.02	5.17±0.04	3.50±0.01	15.40±0.21	54.10±0.04	15.50±0.15	1.86±0.03	1.01±0.02	5.12 ±0.03
Ocimum gratissimum	15.60±0.71	9.79±0.02	3.68±0.03	13.13±0.03	13.22±0.02	44.59±0.05	3.69±0.14	0.55±0.03	0.48± 0.02	2.24 ±0.03
Tetrapleura tetraptetra	19.00±0.68	4.50±0.03	3.27±0.05	4.38±0.05	20.42±0.02	52.01±0.03	1.02±0.15	0.25±0.03	0.11±0.02	0.19 ±0.03
Tamarindus indica	28.40±0.85	16.40±0.01	3.77±0.02	8.75±0.02	24.70±0.01	17.98±0.05	7.54±0.01	0.97±0.03	0.92±0.02	4.60± 0.03
Gongronema latifolium	18.00±0.15	11.68±0.02	7.20±0.04	15.75±0.02	18.00±0.01	29.38±0.03	18.31±0.01	2.17±0.03	1.11±0.02	5.15± 0.07

Antinutritional Composition of selected spices

The antinutritional contents (mg/g) of the selected spices were evaluated and parameters such as tannin, saponin, alkaloid and oxalate contents were quantitatively estimated, results are as presented in Table 2. Anti-nutritional factors are substances that when present in food reduce the availability or utilization of one or more nutrients, thereby altering the expected nutritional status (Popova and Mihaylova 2019). They play a great role in limiting the wider use of many plants in general effect. Oxalates are naturally found in plants and high consumption of oxalate-rich food has been reported to cause kidney stones by means of reaction with calcium, thus, limiting or inhibiting this mineral absorption. The oxalate content of the eight spice samples indicated both *Tamarindus indica* (3.75) and *Piper guineense* (3.47 mg/g) are having the highest values with *Gongronema latifolium* the least (0.63 mg/g) value. Oxalic acid is a normal end product of human metabolic activities and additional consumption of oxalic acid may cause stone formation in the urinary tract. Tannins are generally regarded as anti-nutrients because they interact with proteins and form insoluble complexes, thereby reducing their bioavailability. The results of the current work indicated that *Tamarindus indica* has the highest (6.01mg/g) value *while Gongronema latifolium* has the least 1.28 (mg/g) value. High tannin content has been reported to show tendencies of causing loss of body weight as a result of decrease bioavailability of amino acids. Alkaloids, though an essential group of compounds, however, there presence in high value has deleterious sour taste. *Piper guineese* has the highest alkaloid value of 1.43 mg/g while 0.64 mg/g for *Monodora myristica* is the least. There is no much variations in the alkaloids content as the range 0.64-1.43 mg/g was observed among all the selected spices Saponin content shows that *Tamarindus indica* has the highest value of saponin of 175.83 mg/g followed by *Piper guineense* with 55.64 mg/g while the least is *Gongronema latifolium* with 12.18 mg/g, showing wide variations in the results obtained. Saponin are commonly nonvolatile, surface active secondary metabolites, which are abundantly dispersed in nature but primarily found in plants. Our study was generally higher than those of Ogunka-Nnoka and Mepba (2008), Uhegbu *et al.,* (2011) and those of Evuen *et al*., (2022) and even in common spices although samples were from Southeast, Nigeria.

Table 2: Antinutritional Content of the Selected Spices

	Oxalate	**Tannin**	**Alkaloid**	**Saponin**
	g/100g	GAE/g dry matter	%	%
***Mondora myristic*a**	2.22±0.21	4.11±0.07	0.643±0.00	29.82±0.60
Piper guineense	3.47±0.21	5.10±0.07	1.425±0.22	55.64±0.61
Aframomum melegueta	2.79±0.42	4.48±0.07	0.763±0.11	36.91±0.43
Sygynium aromaticum	2.00±0.21	3.67±0.07	0.870±0.32	18.91±0.60
Ocimum gratissimum	0.90±0.73	3.30±0.07	0.700±0.25	17.64±0.60
Tetrapleura tetraptera	0.77±0.21	3.02±0.07	0.975±0.32	15.64±0.60
Tamarindus indica	3.75±0.21	6.01±0.07	0.825±0.22	175.83±0.60
Gongronema latifolium	0.63±0.02	1.28±0.07	1.125±0.22	12.82±0.60

Values are mean ±standard deviation of the three determinations.

CONCLUSION

The proximate content of a food sample helps to provide information about food value usually refered to as nutrition value. The carbohydrate content has linear relationship with energy value and it serves as an essential source of energy to all cells in the body. The results from this work indicated that *Aframomum melegueta, S. aromaticum and T. tetraptera* has the highest carbohydrate content greater than 50 % and generally indicated that these spices may be a potential in the fortification animal feeds. The result also emphasizes the use of the spices as good sources of antioxidants which could serve as good health supplement most especially *Gongronema latifolium* and *Syzygium aromaticum* because they are high dense in most of the analyzed antioxidants. The antinutritional content were generally very small except in saponin for *T. indica* and *P. guineense* but not as high as rendering the spices unsuitable for consumptions.

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