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NUTRACEUTICAL EVALUATION OF SOME SELECTED INDIGENOUS SPICES FOUND IN KOGI STATE, NIGERIA

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ABSTRACT

This study investigates the proximate composition, mineral content, phytochemical constituents and antioxidant activity of *Parkia biglobosa*, *Prosopis Africana*, *Monodora myristica* and *Pimpinella anisum* seeds collected from Kogi state, Nigeria using standard analytical methods. The results indicated that there were significant differences (P≤0.05) in the spice samples. However, it was revealed that *Parkia biglobosa* had the highest crude fat (17.87±0.02 %) and crude protein content (26.23±0.02 %). *Pimpinella anisum* had the highest crude fibre content (12.74±0.08 %) while *Monodora myristica* had the lowest moisture content (10.54±0.23 %) as well as the highest ash (5.55±0.04) and carbohydrate content (50.14±4.30 %). The presence of phytochemical compounds was detected in the spice samples at various amounts. Phytates, flavonoids, oxalates and phenols were most abundant in *Parkia biglobosa*. Tannins and alkaloids were most abundant in *Prosopis Africana*, while saponins were most abundant in *Monodora myristica*. The mineral analysis in mg/100g indicated that the spices contained appreciable levels of essential minerals, with *Monodora myristica* having the highest calcium, magnesium, potassium, phosphorous and iron concentration of 140.01±0.11 mg/100g, 88.15±0.24 mg/100g, 90.94±0.19 mg/100g, 124.56±0.18 mg/100g and 21.00±0.12 mg/100g respectively. While *Parkia biglobosa* has the highest concentration of sodium at 36.08±0.07. The samples also showed great antioxidant activity, with *Parkia biglobosa* showing the most activity at various concentrations. From the result, it is evident that these selected indigenous spice samples are rich sources of both nutritional and pharmaceutical properties required by man.

Keywords: Proximate composition, Antioxidant activity, Mineral content, Qualitative phytochemical screening, Quantitative phytochemical screening

INTRODUCTION

The investigation of local plant species for their nutritional and medicinal potential has become increasingly popular in the international conversation about healthy eating and sustainable food systems (Nicolétis *et al*., 2019). Local spices have a special chance to bridge the gap between conventional wisdom and modern nutritional science since they are firmly ingrained in cultural and culinary traditions. African locust beans (*Parkia biglobosa*), African mesquite (*Prosopis Africana*), calabash nutmeg (*Monodora myristica*) and anise seed (*Pimpinella anisum*) are four famous native spices that grow in Kogi State in central Nigeria.

According to Ene-Obong *et al*. (2018), spices are described as aromatic or spicy additions used to flavour, colour and preserve food. Most traditional and indigenous foods in Africa, particularly in Nigeria, are made with traditional and indigenous spices. These spices are used in foods to enhance flavour or as additions or treatments for specific illnesses and diseases. In pharmaceuticals, fumigants and textiles, they are also utilized as preservatives to eradicate hazardous germs or stop their growth (Tefera *et al*., 2021). Any component of the plant, including seeds, kernels, bulbs, stalks, roots, bark, leaves, pods and buds, can be a source of spice, whether they are fresh or dried. Many cultures have used them for thousands of years to improve the flavour and scent of food. Indigenous cultures valued spices primarily for their ability to preserve food and for their therapeutic properties.

African locust beans, commonly known as "iru," have been prized by West Africans for their distinctive flavour and probable health benefits since ancient times. The beans also lessen the risk of heart attacks and treat diseases like diabetes and diarrhea while boosting the immune system. It is also used to alleviate the effects of poison, such as those from snake bites and scorpion stings (Olalude *et al*., 2021). A rich oil source, African mesquite seed (okpehe) offers a wide range of bioactive components with demonstrated anti-inflammatory and antioxidant effects (Alagbe, 2020). The nutritious and calorie content of the aromatic calabash nutmeg seeds, known as "Ehuru" in regional languages, makes them crucial in diets. The kernel, which is taken out of the seed, is suitable for usage as a spice in Nigerian cuisines since it has a pleasant aroma. Nkwocha Chinelo *et al*. (2018) claim that it is also used to treat constipation and skin issues. The anise seed, also known as "nkitinkiti," lends food preparations a distinct flavour and has demonstrated potential as a source of bioactive compounds with potential health benefits (Bettaieb Rebey *et al*., 2018).

Despite the significance of these spices in both culture and history, comprehensive nutritional analyses that go beyond their sensory properties are conspicuously lacking. This study aims to comprehensively evaluate the macro and micronutrient composition, as well as the bioactive components, of African locust beans, African mesquite seed, calabash nutmeg and anise seed in light of the growing interest in local food resources. The complex nutritional profiles of these native spices will be revealed by using contemporary analytical techniques, such as proximate analysis, mineral profiling, phytochemical characterization and antioxidant activity.

MATERIALS AND METHODS

Matured accessions of the four distinct indigenous spices were harvested at random from local farms in Lokoja, Kogi

State, communities of Filele, Adankolo, Zangondaji and Sarkin Noma. The samples include varieties of calabash nutmeg (*Monodora myristica*), African mesquite (*Prosopis Africana*), African locust beans (*Parkia biglobosa*) and anise seed (*Pimpinella anisum*). The samples were cleaned by brushing off soil particles and transported to the laboratory for analysis at a tropical ambient temperature.

Figure 1: picture of the variety of indigenous spices

Sample Preparation

The selected samples were thoroughly screened to remove spoilt ones, stones and other unwanted materials. The samples were prepared according to their usage pattern. African locust beans (*Parkia biglobosa*), African mesquite (*Prosopis Africana*) and anise seed (*Pimpinella anisum*) seeds were toasted in a pan over fire for 2 min. The hard shell was removed and the inner kernel was thoroughly grounded into powder with an electric kitchen grinder. The dried hard shell of calabash nutmeg (*Monodora myristica*), was peeled off and the hard seeds were broken into pieces with a hammer, ground into fine powder and stored in an air-tight container. The four samples were stored in airtight properly labelled polythene bags and kept in a cool and dry place before analysis.

Determination of Proximate Composition

To determine the ash content, crude protein, crude fibre, percentage fat and moisture content, standard analytical techniques as outlined by AOAC (2006) were used. Difference was used to compute the carbohydrate content.

Mineral Analysis

Samples were digested for mineral analysis following the procedure outlined by AOAC (2006). 1.00 g of the pulverized sample was weighed and put into a 250 cm^3 beaker. A strong acid mixture of 15.00 cm^3 HNO_3 and 5.00 cm^3 perchloric acid was put into the beaker. A hot plate was used to heat the mixture until a clear digest appeared after it had been properly stirred to ensure adequate mixing. The digest was quantitatively filtered into a 100 cm^3 volumetric flask after being allowed to cool. To aspirate the filtrate into the machine for trace metal analysis, it had to be produced up to the 100 cm^3 threshold.

Qualitative phytochemical screening

The approach suggested by Yadav and Agarwala (2011) was utilized to ascertain the qualitative phytochemical analysis of oxalates, tannins, flavonoids, phytates, phenols, alkaloids and saponins.

Quantitative phytochemical screening

Tannin content determination

In a 50 cm^3 sample bottle, 0.2 g of the finely powdered sample was weighed. A 10% aqueous acetone solution was added and thoroughly coated. The bottles were shaken for two hours at 300C in an ice bath shaker. The supernatant from each solution was then centrifuged and kept on ice. The test tube was filled with 0.8 cm^3 of pure water and 0.2 cm^3 of each solution. Tannic acid solutions with a standard concentration of 0.5 mg/cm^3 were generated by diluting the stock with distilled water to a volume of 1 cm^3. Folin Ciocateau reagent and 2.5 cm^3 of 20% Na_2CO_3 were added to the samples and standard, and the mixture was vortexed before being left to sit for 40 minutes at room temperature. Its absorbance was measured at 725 nm and compared to a blank for the reagent. The concentration of the same solution from a standard tannic acid curve was prepared (Makkar and Goodchild, 1996).

Oxalate content determination

One gram of the sample was soaked in 75 cm^3 of 1.5M H_2SO_4 for 1h before being filtered through
No. 1 Whatman filter paper to quantify the amount of oxalate. A conical flask containing 25 cm^3 of the filtrate was filled with this mixture, which was then heated to between 80-90^oC and titrated against 0.1 M $KMnO_4$ until a pink colour that lasted for 15 seconds was achieved (Day and Underwood, 1986).

Saponin content determination

To determine saponin, the spectrophotometric technique described by Brunner (1994) was applied. A 250 cm^3 beaker containing two grams of the finely ground sample and 100 cm^3 of isobutyl alcohol was weighed. For five hours, the mixture was shaken to achieve even mixing. A 100 cm^3 beaker containing 20 cm^3 of a 40 % saturated solution of magnesium carbonate ($MgCO_3$) was used to filter the mixture using No.1 Whatman filter paper. The resulting mixture underwent a second filtering process using No.1 Whatman filter paper to produce a clear, colourless solution. Using a pipette, 1 cm^3 of the colourless solution was put into a 50 cm^3

volumetric flask along with 2 cm^3 of 5% iron (III) chloride ($FeCl_3$) solution, which was then diluted with distilled water to the desired volume. The colour was allowed to develop for 30 minutes as it stood. At 380 nm, the absorbance was measured in comparison to a blank.

Determination of Total Phenolics Content

The total phenolic content of samples was determined spectrophotometrically using a modified Folin-Ciocalteu colorimetric method by Dewanto *et al*. (2002). To produce values within the standard curve ranges of 0.0-600.0 µg of gallic acid/mL, all samples were diluted 1:5 with distilled water. After that, 0.5 cm^3 of distilled water was added to 125 µL of the standard gallic acid solution or 1:5 diluted samples in a test tube before 125 µL of the Folin-Ciocalteu reagent (FCR) was added. After thoroughly combining the samples, 1.25 cm^3 of an aqueous solution of sodium carbonate at a concentration of 7% was added. The final volume was adjusted to 3 mL by the addition of water. Using an MRX II DYNEX spectrophotometer (DYNEX Technologies, Inc., Chantilly, VA), samples were allowed to stand for 90 min at room temperature before being measured at 760 nm in comparison to the blank and standards made in a similar manner but with known gallic acid contents. For eight replications, all values were presented as the mean (micrograms of gallic acid equivalents per gram of sample) ±SD.

Phytate content determination

Phytates were determined using the method by Ramadan (2012). A No. 1 Whatman filter paper
was used to filter 4 g of the sample after it had been steeped in 100 cm^3 of 2% HCl for three hours. A conical flask was filled with 25 cm^3 of the filtrate, to which 5 cm^3 of a 0.3 % ammonium thiocyanate solution was added as an indicator. Next, 53.5 cm^3 of distilled water was added to the flask to give it the appropriate acidity. This was titrated against a standard iron (III) chloride solution with a concentration of 0.00566 g per millilitre, which contained approximately 0.00195 g of iron per cm^3 until a brownish-yellow coloration remained for 5 minutes.

Determination of Total Flavonoid Content

Total flavonoid content was determined by using a colorimetric method described by Dewanto *et al*. (2002). In a test tube, 0.25 cm^3 of the sample or (+)-catechin standard solution was combined with 1.25 cm^3 of distilled water. Next, 75 µL of a 5% $NaNO_2$ solution was added. After standing for another 5 minutes, 150 µL of a 10% $AlCl_3$–$6H_2O$ solution was added, and after another 6 minutes, 0.5 cm^3 of 1 M NaOH was added. Using pure water, the mixture was well mixed and diluted to 2.5 cm^3. Using an MRX II DYNEX spectrophotometer (DYNEX Technologies, Inc.), the absorbance was immediately measured at 510 nm against a blank and compared to standards made similarly but with known (+)-catechin concentrations. For eight replications, the data are presented as the mean (micrograms of catechin equivalents per gram of tomato) ±SD.

Determination of alkaloid content

The alkaloid content was assessed gravimetrically using Harborne (1984) techniques. Each sample was weighed to equal five grams and then put into a 50 cm^3 solution of 10% acetic acid in ethanol. The mixture was then left to stand for approximately 4 hours before filtering. This was filtered, and the extract was then concentrated to a quarter of its original volume in a water bath. Dropwise addition of concentrated ammonium hydroxide precipitated the alkaloids. The precipitate was removed using a pre-weighed filter paper and then washed with 1% ammonium hydroxide solution. The alkaloid's weight was given as a percentage of the sample weight that was examined.

Antioxidant activity

DPPH-radical scavenging (DPPH-RS) activity

Samples DPPH-RS activity were assessed using the technique outlined by Behbahani and Fooladi (2018). The sample (0.1 cm^3) was added to 3.9 cm^3 of methanolic DPPH solution (0.12 mM) in the test tube. The solution was then violently shaken and left in a dark area for 30 minutes. After that, its absorbance at 517 nm was measured, and the radical-suppressing activity was finally determined as follows:

$$\text{DPPH-radical scavenging activity (\%)} = \frac{Absorbance\ of\ control - Absorbance\ of\ sample}{Absorbance\ of\ control} \times 100\ \%$$

Statistical Analysis

The obtained results were subjected to statistical analysis using mean standard deviation and analysis of variance (ANOVA) as described by Duncan's multiple range test to determine the level of significance between different samples and significance was set at $p \leq 0.05$.

RESULTS AND DISCUSSIONS

Table 1: Proximate composition (%) of selected indigenous spices

Sample	Moisture (%)	Ash (%)	Crude fat (%)	Crude fibre (%)	Crude protein (%)	Carbohydrate (%)
Parkia biglobosa	8.01±0.90	5.05±0.05	17.87±0.02	12.24±0.12	26.23±0.02	30.6±8.42
Prosopis Africana	5.89±0.18	4.00±0.02	10.24±0.01	11.10±0.03	20.45±0.03	49.2±6.54
Monodora myristica	10.54±0.23	5.55±0.04	11.68±0.08	9.25±0.15	12.84±0.12	50.14±4.30
Pimpinella anisum	9.88±0.54	5.18±0.07	9.10±0.04	12.74±0.08	14.89±0.06	48.21±2.80

Values are means ± standard deviation of triplicate analysis**.**

Proximate Composition of Selected Indigenous Spices

The result of the proximate composition of the varieties of indigenous is shown in Table 1. The moisture content of the various indigenous spices ranged from 5.89±0.18 % for *Prosopis Africana* to 10.54±0.23 % for *Monodora myristica*. The result indicates that there was a significant difference ($p \leq 0.05$) in the indigenous spices analysed with *Monodora myristica* showing the highest moisture content. These findings can, however, be compared with those of Michael *et al*. (2021), who reported 6.00% for raw *Prosopis Africana* seed, and Agiriga and Siwela (2018), who reported 8.96±0.09% for raw *Monodora myristica* seeds. This suggests

that *Prosopis Africana* has a greater resilience to deterioration and a longer shelf life when compared to the other indigenous spices examined (Godfrey *et al*., 2023).

Ash contents of the various indigenous spices ranged from 4.00±0.02 % for *Prosopis Africana* to 5.55±0.04 % for *Monodora myristica*. The result indicates that the analysed indigenous spices were significantly different (p≤0.05) with *Monodora myristica* having the highest ash content. These findings were comparable to those of Agiriga and Siwela (2018), who reported 3.46±0.04% for raw *Monodora myristica* seeds, and Michael *et al*. (2021), who reported 3.60% for *Prosopis Africana* seeds. Given that *Monodora myristica* has a higher ash content than the other indigenous spices under investigation, this suggests that it contains the most minerals (Tomori *et al*., 2023).

The fat content in these analysed indigenous spices ranged from 9.10±0.04 % for *Pimpinella anisum* to 17.87±0.02 % for *Parkia biglobosa*. The result indicates that there was a significant difference (p≤0.05) in the indigenous spices analysed with *Parkia biglobosa* showing the highest fat content. These findings, however, were comparable to reports by Ghosh *et al.* (2019), which contained 9.72±0.09 % for *Pimpinella anisum* and Oyerinde *et al*. (2019) that had varieties of *Parkia biglobosa* that ranged from 16.60±0.50 % to 18.07±0.15 %. Accordingly, *Parkia biglobosa* is thought to be a better source of calories than other indigenous spices (Oyerinde *et al*., 2019).

The crude fibre content ranged from 9.25±0.15 % for *Monodora myristica* to 12.74±0.08 % for *Pimpinella anisum*. The result indicates that the analysed yam species were significantly different (p≤0.05) with *Pimpinella anisum* having the highest crude fibre content. However, this result can be compared with reports by Ene-obong *et al*. (2018), which had 8.2% for *Monodora myristica* seeds, and Ghosh *et al*. (2019), which had a range of 12.6±0.01% to 13.14±0.05% for species of *Pimpinella anisum*. Studies show that the consumption of fibre lowers the risk of obesity, heart disease, diabetes and softens stools (Nkwocha Chinelo *et al*., 2018).

The crude protein content of the variety of spices ranged from 12.84±0.12 % for *Monodora myristica* to 26.23±0.02 % for *Parkia biglobosa*. The result indicates that the analysed indigenous spices were significantly different (p≤0.05) with *Parkia biglobosa* having the highest crude protein content. The results, however, can be compared with those from studies by Nkwocha Chinelo *et al*. (2018), which indicated 12.09±0.52% for *Monodora myristica*, and Coulibaly *et al*. (2022), which showed *Parkia biglobosa's* crude protein to be 31.67±0.57%. This reveals that *Parkia biglobosa*, out of the indigenous spices investigated, is superior for tissue repair and growth as well as the building and functioning of cells (Olalude *et al*., 2021).

The carbohydrate content of the spice varieties ranged from 30.6±8.42 % for *Parkia biglobosa* to 50.14±4.30 % for *Monodora myristica*. The result indicates that the analysed indigenous spices were significantly different (p≤0.05) with *Monodora myristica* having the highest carbohydrate content. However, these values are comparable to the results by Olalude *et al*. (2021) which had 37.34% % for *Parkia biglobosa* seeds, and in contrast with Nkwocha Chinelo *et al*. (2018) who reported 35.92±0.50 % for *Monodora myristica*. All living things are thought to use carbohydrates as their main source of energy (Ojinnaka *et al*., 2016).

Table 2: Mineral content (Mg/100g) of selected indigenous spices

Sample	Calcium	Magnesium	Potassium	Phosphorous	Sodium	Iron
Parkia biglobosa	10.85±0.15	36.50±0.18	40.01±0.17	74.16±0.16	36.08±0.07	3.43±0.03
Prosopis Africana	34.10±0.05	16.00±0.08	32.60±0.14	55.04±0.05	10.45±0.04	1.08±0.01
Monodora myristica	140.01±0.11	88.15±0.24	90.94±0.19	124.56±0.18	17.80±0.02	21.00±0.12
Pimpinella anisum	14.45±0.08	5.10±0.02	35.20±0.06	11.84±0.03	2.10±0.01	13.43±0.06

Values are means ± standard deviation of triplicate analysis.

Mineral Concentration of Selected Indigenous Spices

The result of the mineral concentration of some selected indigenous spices found in Kogi state, Nigeria is shown in Table 2. The calcium content in this study ranged from 10.85±0.15 mg/100g for *Parkia biglobosa* to 140.01±0.11 mg/100g for *Monodora myristica*. The result indicates that there was a significant difference (p≤0.05) in the spices analysed with *Monodora myristica* showing the highest calcium concentration. This concentration, however, is lower than the value reported by Ene-obong *et al*. (2018), who reported 590 mg/100g for their *Monodora myristica* sample, and comparable to findings by Olalude *et al*. (2021), which had 9.01 mg/100g for matured *Parkia biglobosa* seeds. Blood coagulation, the development of bones and teeth, the contraction of muscles and neurological function all require calcium (Trailokya *et al*., 2017). For children, 500–800 mg/day of calcium is advised, while for adults, 1000 mg/day is advised (WHO, 2014).

Magnesium was also present in the range of 5.10±0.02 mg/100g for *Pimpinella anisum* to 88.15±0.24 mg/100g for *Monodora myristica*. The result indicates that the analysed yam species were significantly different (p≤0.05) with *Monodora myristica* having the highest magnesium concentration. However, its results were higher than those reported by Sun *et al.* (2019) who reported no detectable amount of magnesium concentration in its *Pimpinella anisum* seeds, and Adebola *et al*. (2017) who reported 86.8 mg/100g for *Monodora myristica* seeds. According to Mergedus *et al*. (2015), among other things, magnesium plays a role in muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, poor spermatogenesis, congenital anomalies and bleeding problems. 80 to 320 mg/day of magnesium is the recommended dietary requirement (WHO, 2014).

In this study, the concentration of potassium ranged from 32.60±0.14 mg/100g for *Prosopis Africana* to 90.94±0.19 mg/100g for *Monodora myristica*. The result indicates that the analysed samples were significantly different (p≤0.05) with *Monodora myristica* having the highest potassium concentration. However, these values were comparable with reports by Aremu *et al*. (2015) who had 30.60 mg/100g for raw *Prosopis Africana* seeds, and Nkwocha *et al*. (2019) who reported 89.17±0.1 mg/100g for raw *Monodora myristica* seeds. Potassium has a crucial role in the control of the immunological response, neurotransmission, signalling and water balance in the body (Godfrey *et al*., 2022). For adults,

the recommended dietary intake of potassium is 2000 mg, and for children, it is 1000 mg (WHO, 2014).

The phosphorus content of the samples analysed ranged from 11.84±0.03 mg/100g for *Pimpinella anisum* to 124.56±0.18 mg/100g for *Monodora myristica*. The result indicates that the analysed yam species were significantly different ($p \leq 0.05$) with *Monodora myristica* having the highest phosphorous concentration. However, these values are low in comparison to reports by Ene-obong *et al*. (2018), who reported 680 mg/100g for raw seeds of *Monodora myristica*. Together with calcium, phosphorus helps to strengthen bones and teeth, especially in young children and nursing mothers. 800 mg/day is the recommended dietary intake for both adults and children (WHO, 2014).

The sodium concentration in this study ranged from 10.45±0.04 mg/100g for *Prosopis Africana* to 36.08±0.07 mg/100g for *Parkia biglobosa*. The result indicates that there was a significant difference ($p \leq 0.05$) in the yam species analysed with *Parkia biglobosa* showing the highest sodium concentration. However, the sodium concentration was comparable to that reported by Aremu *et al*. (2015) for *Prosopis Africana* seeds, which had 9.00 mg/100g, and Olalude *et al*. (2021), for *Parkia biglobosa* seeds, which had 35.00 mg/100g. The excitation and transmission of nerve impulses during action are two metabolic processes in which sodium, a macronutrient, is crucially involved (Godfrey *et al*., 2022). For adult males, the recommended daily sodium consumption is 10 mg, while for females, it is less than 15 mg (WHO, 2014).

Iron concentrations in the sample ranged from 1.08±0.01 mg/100g for *Prosopis Africana* to 21.00±0.12 mg/100g for *Monodora myristica* samples. The result indicates that the analysed yam species were significantly different ($p \leq 0.05$) with *Monodora myristica* having the highest iron concentration. However, this result was comparable to results reported by Mergedus *et al*. (2015) who reported 0.80 mg/100g for raw *Prosopis Africana* seeds, and Adegbola *et al*. (2017) who reported 21.74 mg/100g for *Monodora myristica* seeds. Hemoglobin, a type of protein found in red blood cells that transports oxygen from the lungs to every region of the body, contains a significant amount of iron (Georgieff, 2020). For children, 13.7–15.1 mg/day of iron is recommended, while for adults, 17.0–18.9 mg/day is recommended (WHO, 2014).

Table 3: **Qualitative phytochemical screening of selected indigenous spices**

Sample	Saponin	Tannin	Alkaloid	Phytate	Flavonoids	Oxalate	Phenols
Parkia biglobosa	+	+	++	++	++	+	+++
Prosopis Africana	+++	+	+++	+	+	-	+++
Monodora myristica	+++	+	+	++	-	-	+++
Pimpinella anisum	+	+	+	+	+	-	+++

Key: +++ = Present in high amount; ++ = Present in moderately high amount; + = Present in trace amount; - = Absent

Qualitative phytochemical screening of Selected Indigenous Spices

Qualitative phytochemical screening of the crude extracts of *Parkia biglobosa*, *Prosopis Africana*, *Monodora myristica* and *Pimpinella anisum* seeds revealed the presence of some important bioactive components as shown in table 3. Phenol was present in high amounts in all the samples analysed. *Parkia biglobosa* showed the presence of alkaloids, phytate and flavonoids in moderately high amounts, while saponin, tannin and oxalate were present in just trace amounts. *Prosopis Africana* showed the presence of saponin and alkaloids in very high amounts. Tannins, phytate and flavonoids were also detected in trace amounts, while oxalate was absent. Furthermore, *Monodora myristica* had no flavonoids and oxalate but showed the presence of saponin and phytate in very high amounts and moderately high amounts respectively while tannins and alkaloids were detected in trace amounts. Except for oxalates that were absent, saponins, tannins, alkaloids, phytates and flavonoids were all present in trace amounts in *Pimpinella anisum.* The spices are rich sources of phytocompounds which can be used in the synthesis of drugs. The result agrees with the findings of Kadam *et al*. (2015); Nkwocha Chinelo *et al*. (2018); Olorunmaiye *et al*. (2019) and Okwu (2001). Due to the presence of significant biological activities, phytochemical compounds can be used as antioxidants, in allopathic systems, as anti-carcinogens, anti-inflammation, cardiovascular protection, cell proliferation activities, lowering blood pressure, treatment of congestive heart failure and cardiac arrhythmia, as well as for the treatment of cough, asthma, and hay fever (Shreya *et al*., 2015).

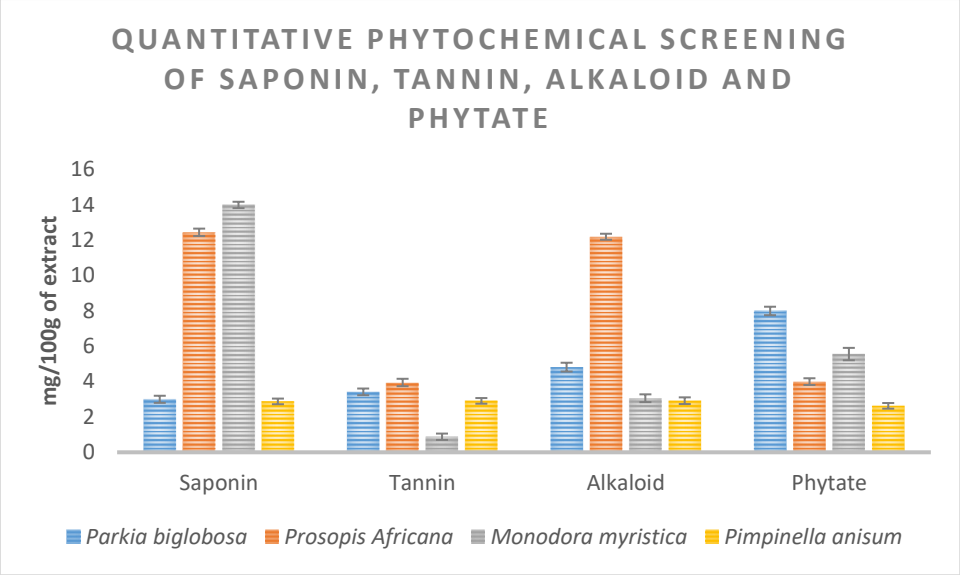

Figure 2: Quantitative phytochemical screening of saponin, tannin, alkaloid and phytate

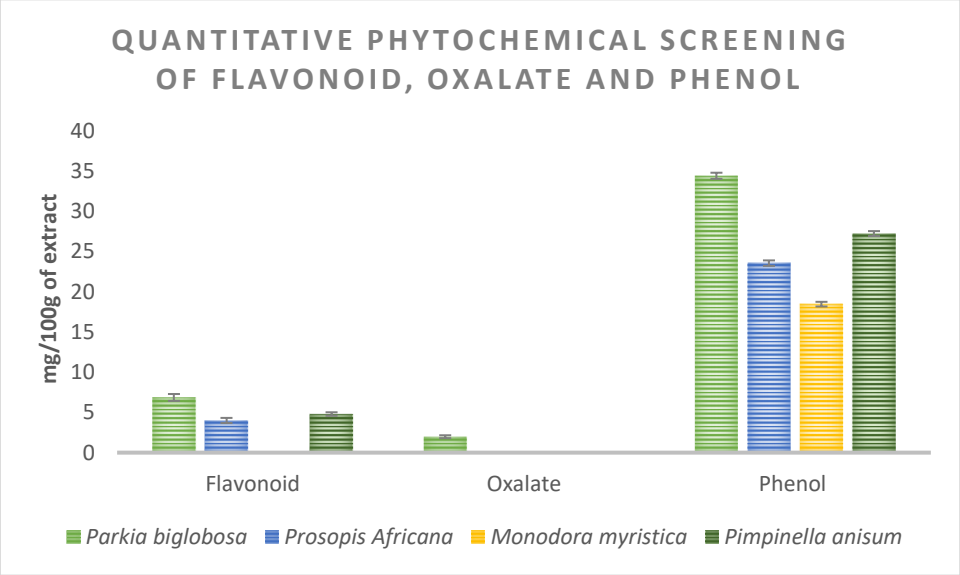

Figure 3: Quantitative phytochemical screening of flavonoid, oxalate and phenol

Quantitative phytochemical screening of Selected Indigenous Spices

The quantitative phytochemical screening of the crude extract of *Parkia biglobosa*, *Prosopis Africana*, *Monodora myristica* and *Pimpinella anisum* seeds is shown in Figure 2 and Figure 3. The saponin content in the various spice samples ranged from 2.88±0.16 mg/100g for *Pimpinella anisum* to 14.00±0.18 mg/100g for *Prosopis Africana*. However, the result can be compared to reports by Nkwocha Chinelo *et al*. (2018) who had 12.04±3.33 mg/100g for *Monodora myristica* seeds and higher than Tushar *et al.* (2023) that had 0.82 mg/100g for *Pimpinella anisum* sample. According to Mugford and Osbourn (2013), saponins have been shown to have detergent and emulsifying capabilities, anti-fungal and anti-microbial characteristics, anti-inflammatory qualities, the ability to decrease cholesterol and anti-cancer effects.

The tannin content in the various spice samples ranged from 0.88±0.08 mg/100g for *Monodora myristica* to 3.95±0.21 mg/100g for *Prosopis Africana*. However, the result can be compared to reports by Nkwocha Chinelo *et al*. (2018) who had 0.51±0.03 mg/100g for *Monodora myristica* seeds and higher than Michael *et al*. (2021) who had 2.35±0.63 mg/100g for *Prosopis Africana* raw seed sample. Tannins are beneficial for protecting against UV rays, having antioxidant, antiviral, anti-parasitic, antidiarrheal and wound-healing capabilities (Tong *et al*., 2022).

The alkaloid content in the various spice samples ranged from 2.92±0.19 mg/100g for *Pimpinella anisum* to 12.20±0.17 mg/100g for *Prosopis Africana*. However, the result was higher than Tushar *et al.* (2023) that had 0.92 mg/100g for the *Pimpinella anisum* sample and comparable to reports by Shuaib–Babata *et al.* (2019) who had 11.70 mg/100g for *Prosopis Africana* seeds. According to Ajebli *et al*. (2002), alkaloids have been shown to have anti-diabetic, anti-inflammatory, antioxidant, analgesic, cough-suppressing and antispasmodic activities.

The phytate content in the various spice samples ranged from 2.63±0.16 mg/100g for *Pimpinella anisum* to 8.00±0.24 mg/100g for *Parkia biglobosa*. However, the result is comparable to reports by Oloyede *et al*. (2019) who reported 8.825 mg/100g for *Parkia biglobosa* seeds. According to

Bloot *et al*. (2023), phytates have anti-inflammatory, antioxidant, anti-cancer, and mineral storage capabilities.

The flavonoid content in the various spice samples ranged from 0.01±0.00 mg/100g for *Monodora myristica* to 6.86±0.43 mg/100g for *Parkia biglobosa*. However, regardless of how minute the result is, it was higher than Nkwocha Chinelo *et al*. (2018) who had 0.00±0.00 mg/100g for the *Pimpinella anisum* sample and comparable to reports by Coulibaly *et al*. (2022) who reported 4.66±0.43 mg/100g for *Parkia biglobosa* seeds. flavonoids have been known to help prevent bone loss and have anti-inflammatory and antioxidant properties, anti-cancer and anti-allergic properties (Karak, 2019).

The oxalate content in all the various spice samples was negligible at 0.01±0.00 mg/100g except for *Parkia biglobosa* which had 1.98±0.18 mg/100g. However, the result is comparable to reports by Agiriga and Siwela (2018) who had 0.12±0.06 mg/100g for *Monodora myristica* seeds and Oloyede *et al*. (2019) who had 1.260 mg/100g for *Parkia biglobosa* seeds. Oxalates have been known to have antioxidant properties, help the body eliminate excess waste and maintain metabolic balance and remove excess calcium and oxalate from the blood (Bargagli *et al*., 2020).

The phenol content in the various spice samples ranged from 18.46±0.29 mg/100g for *Pimpinella anisum* to 38.42±0.38 mg/100g for *Parkia biglobosa*. However, the result was comparable to reports by Agiriga and Siwela (2018) who had 21.94±0.10 mg/100g for *Monodora myristica* seeds and Coulibaly *et al*. (2022) who had 53.42±6.10c mg/100g for *Parkia biglobosa* seeds. According to Niwoye *et al*. (2019), phenols are known for their ability to reduce inflammation and act as antioxidants.

Table 4: DPPH radical scavenging activity (%) of some selected indigenous spices

	Concentrations (µg/mL)				
Sample	**25**	**50**	**75**	**150**	**300**
Parkia biglobosa	72.45±0.04	74.35±0.01	77.82±0.06	82.41±0.05	88.86±0.03
Prosopis Africana	54.88±0.03	56.54±0.02	58.97±0.04	62.24±0.00	66.12±0.02
Monodora myristica	34.11±0.05	36.35±0.00	38.12±0.01	42.45±0.01	48.56±0.05
Pimpinella anisum	70.87±0.02	73.24±0.01	75.65±0.02	78.55±0.02	84.87±0.02
Ascorbic acid	86.56±0.05	87.43±0.04	89.45±0.05	92.33±0.04	95.56±0.03
Gallic acid	85.46±0.03	86.11±0.03	88.54±0.01	91.34±0.06	93.59±0.05

Values are means ± standard deviation of triplicate analysis.

Antioxidant Activity of Selected Indigenous Spices

It is common practice to evaluate the antioxidant potential of naturally occurring foods and plants using their capacity to scavenge DPPH free radicals. The comparative DPPH scavenging abilities of the various extracts in comparison to the reference standards (ascorbic acid and gallic acid) are displayed in Table 4. All the extracts from this Table show an inhibitory potential against DPPH free radicals. The percentages of inhibition range from 34.11±0.05% for the methanolic extract of *Monodora myristica* seeds to 72.45±0.04% for the methanolic extract of *Parkia biglobosa*. Comparing the extract samples examined at the various concentrations, the *Parkia biglobosa* seeds have the highest and most significant ($p<0.05$) inhibitory potential. For the range of spice samples they analysed, the results are comparable to those reported by Uyoh *et al*. (2013); Ghosh *et al*. (2019) and Olanrewaju *et al*. (2019). The scavenging activities of the tested extracts were however not comparable to those of ascorbic acid (86.56±0.05 %) and gallic acid (85.46±0.03 %) used as reference standards. DPPH scavenging activities of the tested samples were observed to be dose-dependent, with higher concentrations of each sample showing higher scavenging activities.

CONCLUSIONS

This study examined four different plant species: *Monodora myristica*, *Parkia biglobosa*, *Pimpinella anisum* and *Prosopis Africana*, for their proximate composition, mineral content, phytochemical screening, and antioxidant activity. The distribution of the researched plants' macronutrients was revealed by the proximate composition analysis, offering light on their potential as dietary sources. The examination of the mineral content revealed the existence of different minerals and highlighted their potential benefits for general human health and well-being. The phytochemical screening also sheds light on the wide variety of secondary metabolites that are present in these plant species. The antioxidant and possible therapeutic characteristics of these substances, which include flavonoids, phenolics, and alkaloids, hold hopeful implications. The strong free-radical scavenging potential of these plants was validated by the antioxidant activity assessment, further highlighting their potential health benefits.

This study demonstrates the unique nutraceutical qualities of the plants *Monodora myristica*, *Parkia biglobosa*, *Pimpinella anisum*, and *Prosopis Africana*. The knowledge gathered from this research may open the door to additional investigation into the possible uses of these plants in functional foods, nutraceuticals and pharmaceuticals as the demand for natural and plant-based therapies rises.

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