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Full Length Research Article

PROXIMATE ANALYSIS OF TEN SELECTED SPICE PLANTS FOR ENHANCED NUTRITION AND HEALTH BENEFITS

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ABSTRACT

Herbs and spices have been an integral part of man's food either for their taste, colour, flavour and their nutritional value. Ten Spice plants belonging to six families were collected, cleaned, pulverized and analysed for their percentage proximate composition using standard procedures. The result revealed that all spice plants had acceptably and favourably low amount of percentage moisture. Allium cepa and Xylopia had the highest percentage of carbohydrates, Parkia top the chart for protein followed by Allium sativum and Monodora. Ocimum had the highest percentage of ash and fibre content while Parkia was richest in fat. The paper recommends that harnessing these spices in our daily diet could go a long way in enhancing nutrition by improving the immune function, Boosts energy, enhance mental and body health, support growth and development. It could also lead to better therapeutic options and dietary recommendations for individuals at risk of chronic disease as the body will be sure of getting all the nutrients it needs to thrive..

Keywords: Medicinal Plants, Spices, Proximate, Nutrition

INTRODUCTION

Aromatic plants (*Herbs and spices) are not only used as food enhancers but also contain and* provide nutrients like protein, fibre, volatile components (essential oils), vitamins, minerals and secondary metabolites (phytochemicals) to man as they contribute greatly to the promotion of human health due to the various properties of these nutrients. Numerous researchers like Salbiah *et al.*(2015), Abubakar *et al.* (2019), Shokoh *et al*. (2020) have reported the culinary and medicinal importance of Herbs and Spices. Their investigation revealed that due to the rich constituents of nutrients and phytochemicals in Spices, they are used to treat illnesses such as headache, fever, abdominal, respiratory, circulatory, nervous disorders. They also possess properties like immune boaster, antihypertensive, anti-inflammatory, antioxidant and anticancer.(Shokoh *et al*. 2020).control).

Table 1: List of plants and their names

S/N	Botanical Names	Family	Common Names	Hausa	Igbo	Yoruba	Part used
1	*Ocimum gratissimum*	*Lamiaceae*	Scent leave African basil	Daidoya	Nchanwu	Effinrin	Leaves
2	*Apium graveolens*	*Apiaceae*	Celery	Seleri ganye	Celery	Seleri	Leaves
3	*Allium cepa*	Amaryllidaceae	Onion	Albasa, Katakata	Yabasi	Alubosa	Bulb
4	*Afromomum melegueta K. Schum.*	Zingiberaceae	Alligator pepper, grains of paradise	Kanin fari	Ose oji	Atare	Seed
5	*Xylopia aethiopica*	Annonaceae	Negro pepper	Kimba	Uda	Eeru	Bud
6	*Pentaclethra macrophylla Benth*	Fabaceace	Oil bean	---	Ugba/Ukpaka	Apara	Seed
7	*Allium sativum*	Amaryllidaceae	Garlic	Tafarunna	Ayuu	Ayo	Clove
8	*Cuminum cyminum*	*Apiaceae*	Cumin	Kamoon	Jire/cumin	Irugbin kumini	Seed
9	*Parkia biglobosa jacq.) R. Br.ex G.Don*	Fabaceace	Locust Bean	Dadawa	Ogiri/ Origili	Iru	Seed
10	*Monodora myristica*	Annonaceae	African nutmeg	Gujiya dan miya	Ehuru ofia	Ariwo	Seed

MATERIALS AND METHODS

Sample Collection And Authentication

Scent leave and celery were collected from an herbal garden in Barnawa area of Kaduna.They were cleaned, rinsed properly and shade dried under room temperature(37oc)for almost two weeks. while the others were purchased from the central market Kaduna, The spices collected were identified by NDA/BIOH/AFAKA-KAD and voucher numbers were assigned to them.(NDA/BIOH/202501,NDA/BIOH/202502,NDA/BIOH1,/202501, NDA/BIOH/202503, NDA/BIOH/202504, NDA/BIOH/202505 and NDA/BIOH/202506). The samples were then carefully pulverized to fine powder and stored in labelled airtight containers. Mortar and pestle were used in preparing the spices after shade drying in case of herbaceous spices while grinder was used for the dry grain spice materials.

Proximate Analysis

The proximate analysis of the 10 spices for the percentage moisture, carbohydrate, crude fat, Fibre content, crude protein and ash was carried out in accordance with the Standard Methods of the Association of Official Analytical Chemists (AOAC, 2015) and British Pharmacopoeia (1973) Total carbohydrates was estimated by finding the difference from 100.i e 100-(%protein+% moisture+% crude fats+ % ash content).

Moisture Content

A nickel crucible of appropriate size was weighed and the weight recorded. Exactly 3g of the powdered sample was weighed into the crucible and reweighed. The container was then placed in an oven at 105 ^{o}C for approximately 1h after which it was removed from the oven, covered, cooled in a desiccator and weighed. The process was repeated at 30mins interval in succession until constant weight was achieved.

The percentage moisture was calculated and recorded (wet weight basis) as follows:

$$\text{Percentage Moisture} = \frac{100\,(P\text{-}a)}{P}\ \%$$

P = weight in g of sample (before heating)
a = weight in g of dried sample (final constant)

Crude Protein Content

Exactly, 3g of the spice sample was weighed accurately and placed in a digestive flask. Sequentially, 15g of Na_2SO4, 1g of CuSO4, one or two salinized boiling granules and 25 mL of Conc. H_2SO_4 were added to the flakes. The mixture was digested until solution is almost colourless or light green for at least a further 30 minutes ensuring that no part of the kjeldahl flask is heated above the level of the digestion mixture. The mixture was then Cooled (not allowed to solidify), and 200 mL water was cautiously added. Additional boiling granules was added when necessary to prevent bumping.

1 mL Conway's indicator was added to 100 mL 0.1 NHCl Pipetted into a 500 mL lerlenmeyer flask, the flask was then placed under a condenser ensuring that the condenser tip was immersed in the acid solution. (volume of standardized HCl used in distillation varies according to the expected nitrogen content of the sample). The Kjeldahl flask containing the digested sample was tilted and 100 mL of 50% NaOH solution was then slowly added down the side of the Kjeldahl flask so that it forms a layer underneath the digestion mixture. The flask was then Immediately connected to the distilling bulb of the distillation apparatus to thoroughly mix contents. It was then heated until all ammonia had passed over into the standard acid. Collecting approximately 150 mL before removing immediately avoiding prolonged boiling and too rapid distillation of acid during digestion. The tip of condenser was washed and excess standard HCl was titrated in distillate with NaOH standard solution

Percentage Nitrogen was calculated and recorded as follows:

$$\% \text{ Nitrogen} = \frac{(A\text{-}B) \times 1.400}{\text{Weight of sample (g)}} \times 100$$

Where:
A = vol. (mL) standard HCl x normality of standard HCl
B = vol. (mL) standard NaOH x normality of standard NaOH
Percentage protein was calculated as follows: % PROTEIN = % nitrogen x 6.25
Where 6.25 is the protein-nitrogen conversion factor

Crude Fat

Fat beakers were lined up in front of the extractor with corresponding thimbles. Thimble holders were used to hold the thimbles into positions on the extractor. About 40 mL of diethyl ether was added to each fat beaker slipping the beaker into the ring clamp and tightly clamping the beaker onto the extractor after which another gasket was inserted inside the ring. The heater is then raised into position and switched on. Extraction was done for 4hrs on a Hi setting the condensation rate of 5 to 6 drops per second. After extraction, the heater was lowered, the power and water were shut off and the ether was allowed to drain out of the thimbles.

Distillation and weighing

The thimble was then removed from the holder and rinsed with small portion of diethyl ether before clipping an ether reclaiming tube in place and reattaching the fat beaker. The heater was repositioned, water and power were turned on for distillation of the ether using Hi setting. Distillation continued until a thin layer of ether was remaining in the bottom of the beaker after which the heat was lowered, water and power were then shut off. The exterior of beaker was wiped clean with a Kim wipe after it was removed from the extractor. The reclaiming tubes were emptied into the "USED" diethyl ether container.

The tray of beakers was placed in an operating hood to finish evaporating the ether. A steam bath was used to speed up the evaporation. Beakers remained in the hood until all traces of ether were gone. They were then placed in a 102°C gravity convection oven for about half an hour to dry completely. This was done with great care to avoid excessive drying which may oxidize the fat and give a high value. It was finally Cooled in a desiccator, weighed and recorded weight to the nearest 0.1 mg (W2). The fat beakers were warmed on a steam bath, a little amount of ether was used to dissolve the fat.

Percentage Crude Fat (Ether Extract),

$$\% \text{ crude fat} = \frac{(W_2 - W_1)}{\text{Weight of Sample (g)}} \times 100$$

Where:
W1 = weight of beaker in grams
W2 = weight of beaker and fat residue in grams

Crude Fibre

Accurately 1 g of grinded sample (W) was weighed into a crucible

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(W1) approximately with 1 mg. ==> W1. This was recorded. 1.25% sulfuric acid was added up to the 150 ml notch, after preheating by the hot plate to reduce the time required for boiling. After which 3-5 drops of n-octanol was added as antifoam agent. The mixture was allowed to boil for exactly 30mins and a vacuum was connected to drain the sulfuric acid. 30 ml (crucible filled up to the top) of hot deionized water was used to wash it three times connecting each time to compressed air for stirring the content of crucible. After draining the last wash, 150 ml of preheated potassium hydroxide (KOH) 1.25% and 3-5 drops of antifoam were added. Allowed to boil for 30 minutes, filtered and washed again. The last wash was Performed with cold deionized water aimed to cool the crucibles and then the crucible content was washed three times with 25 mL of acetone, stirring each time by compressed air. The crucibles were removed and the dry weight determined after drying in an oven at 105 °C for an hour or up to constant weight, it was then allowed to cool in a desiccator and later weighed (W2). The weight represents the crude fibre plus ash content in comparison to initial weight.
Percentage Crude Fiber was calculated:

$$\% \text{ crude fibre} = \frac{(W2 - W1)}{W} \times 100$$

Total Ash
About 2g of each sample was accurately weighed in a crucible which was ignited and tared. The crucible was placed in a drying oven at 105°C for 24 hours. It was then transferred to a cool furnace and a step wise increase the temperature to 550 °C ± 5 °C. The temperature was maintained for about 8 hours until a white ash was obtained after which the crucible was removed to a desiccator to cool and weighed.
Percentage ash content was calculated as follows:

$$\% \text{ Ash} = \frac{(\text{wt crucible and ash} - \text{wt crucible})}{(\text{wt. crucible and sample} - \text{wt crucible})} \times 100$$

Carbohydrate
% CHO = % DM - (% EE + % CP + % ash + % CF)
Where: DM = dry matter
EE = ether extract or crude lipid/fat
CP = crude protein
CF = crude fibre

RESULTS
Table 2: Nutrient Composition of Selected Spicy Plants (%)

Prox Imate	Ocimum %	Apium %	A. cepa %	Aframo mum %	Xylopia %	Pentaclethra %	A sativum %	Cuminum %	Parkia %	Monodora
CHO	53.81^{d}	56.25^{e}	**63.32**^{f}	53.99^{d}	**63.15**^{f}	56.19^{e}	56.28^{e}	52.42^{c}	31.19^{a}	49.43^{b}
Protein	5.26^{a}	14.59^{c}	15.76^{d}	14^{c}	8.75^{b}	17.51^{e}	**25.68**^{h}	21.01^{f}	**35.01**^{i}	22.76^{g}
Moisture	**8.67**^{g}	5.89^{e}	**10.22**^{h}	7.00^{f}	5.00^{c}	5.33^{d}	4.67^{b}	3.67^{a}	3.89^{a}	4.56^{b}
Ash	**8.67**^{f}	3.00^{c}	4.00^{d}	3.83^{d}	**4.83**^{e}	3.00^{c}	**4.00**^{d}	3.00^{c}	2.00^{a}	2.50^{b}
Fibre	**11.33**^{d}	7.00^{e}	3.67^{a}	6.33^{f}	**8.00**^{c}	3.00^{f}	5.33^{b}	4.00^{g}	2.33^{i}	3.00^{h}
Fat	12.27^{g}	13.30^{e}	2.97^{bc}	14.83^{e}	10.27^{f}	14.97^{ab}	4.03^{d}	**15.90**^{c}	**25.57**^{a}	**17.43**^{ab}

Mean values with different superscript on the same column are significantly different at ($P \leq 0.05$). Each value is a mean of three replicate ±SE using Duncan multiple test

The table above shows the percentage quantity of carbohydrate, protein, moisture, ash, fibre and fat content in each of the ten spice plants. *Allium cepa* and *Xylopia aethiopica* had the highest percentage of carbohydrates, *Parkia* top the chart for protein followed by *Allium sativum* and *Monodora myristica*. *Allium cepa* contains the highest amount of moisture. *Ocimum gratissimum* had the highest percentage of ash and fibre content while *Parkia biglobosa* was richest in fat.

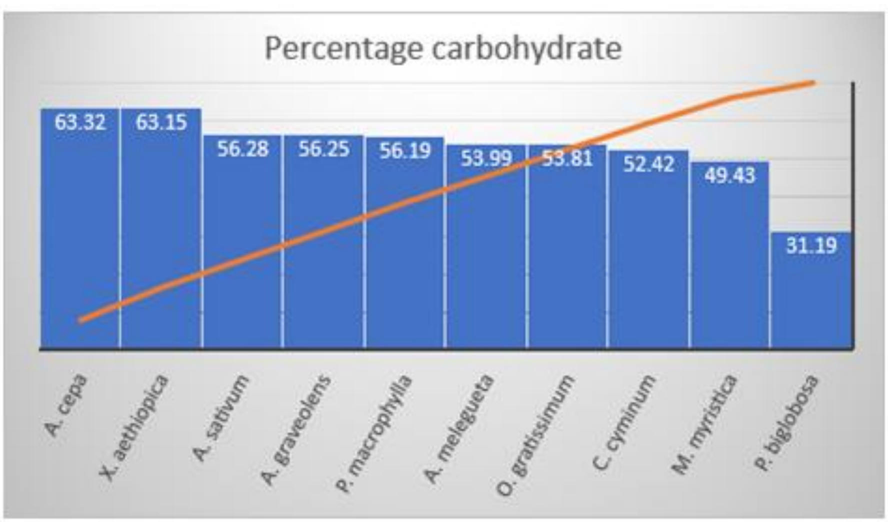

Figure 1: Data Visualization of Proximate Carbohydrate Concentration in all ten spice plants

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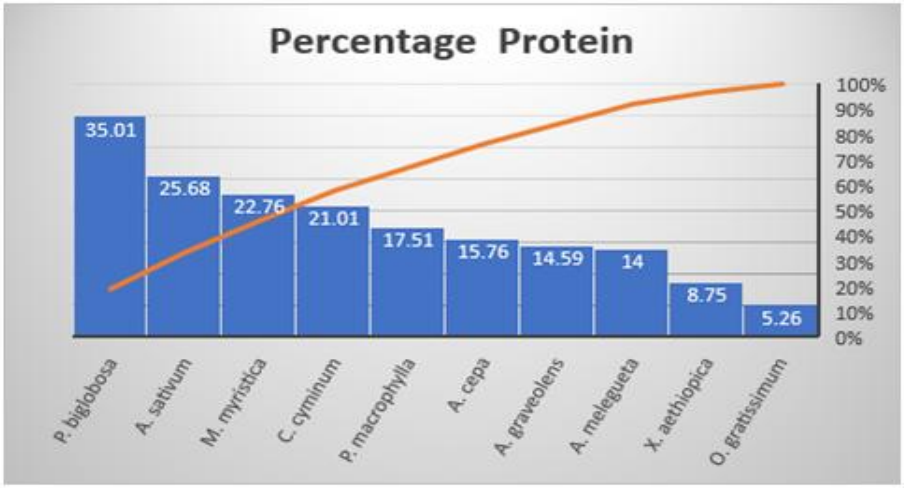

Figure 2: Data Visualization of Proximate Protein Concentration in all ten spice plants

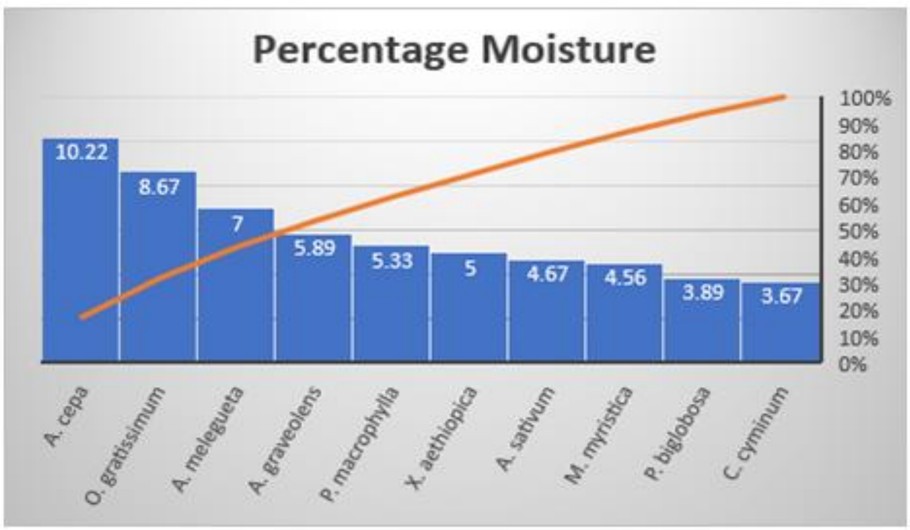

Figure 3: Data Visualization of Proximate Moisture Concentration in all ten spice plants

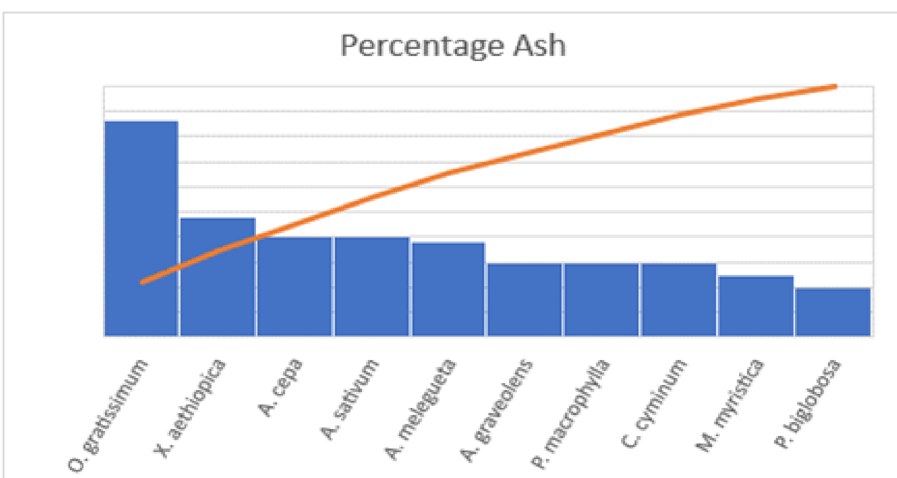

Figure 4: Data Visualization Proximate Ash Concentration in all ten spice plants

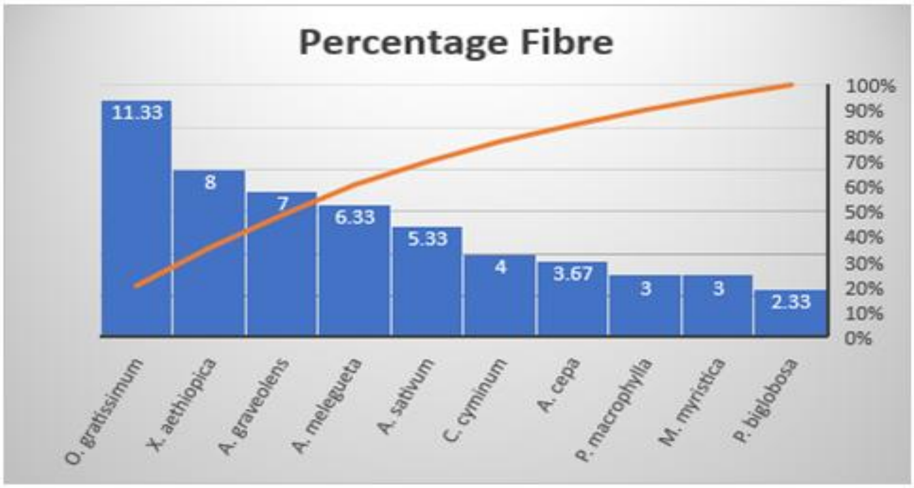

Figure 5: Data Visualization Proximate Fibre Concentration in all ten spice plants

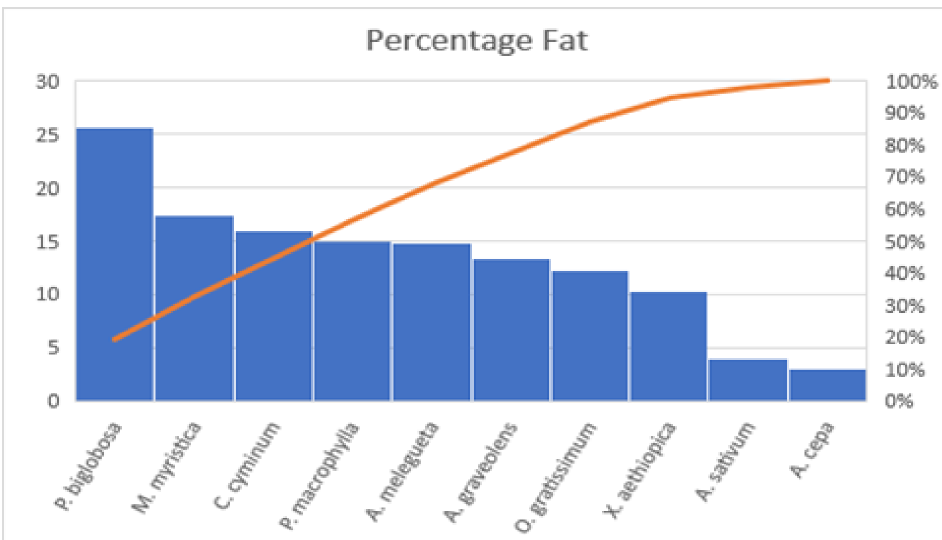

Figure 6: Data Visualization of Proximate Fat Concentration in all ten spice plants

DISCUSSION

Water is an important solvent in which most metabolic, biochemical, enzymatic reactions occur within the body. According to Dalhat *et al.* (2018), food substances with water content that is less than 12% are more susceptible to high biochemical reactions and usually have short shelf life. The moisture content of all ten selected spices were 8.67% for *Ocimum gratissimum*, 5.89% for Apium, 10.22% for A. cepa,7.00% for *Aframomum melegueta. Xylopia* had 5.00%, *Pentaclethra* had 5.33% *Allium sativum* had 4.67%, 3.67% for *Cyminum*, 3.89% for *biglobosa* and *Myristica* had 4.56%.

These values showed that the spices all had moisture content lower than 12% and by implication they can be stored for a long period of time without undergoing spoilage as a result of micro-organisms and excessive biochemical reactions. *Parkia biglobosa* and *Allium sativum* showed significantly highest percentage crude protein of 35.01% and 25.68% respectively while *Ocimum gratissimum* had the lowest value of 5.26% Crude protein content. Others had relatively significant content. Since protein is known to be a body building essential food nutrient, consuming these spices in a regular basis will provide the body with the necessary amino acids to support the cells. Protein rich spices could also be used **as** valuable dietary supplement in malnourished people.

Carbohydrate contributes greatly and add to the nutritional value of every meal taken. From the research, Percentage carbohydrate content, there was no significant difference between the value for *Allium cepa* and *Xylopia aethiopica* with the highest values of 63.32% and 63.15 respectively Also, there was no significant difference between the carbohydrate value for *Apium graveolens* with 56.25%, *Pentaclethra microphylla* with 56.19% and *Allium sativum* with 56.28% but they were significantly different from *Ocimum* with 53.81%, *A. melegueta* with 53.99%, *Cuminum cyminum* with 52.42%. *Monodora myristica* with 49.43% and *P.*

biglobosa with the lowest carbohydrate value of 31.19%. The high carbohydrate content in the spices is suggestive of its high caloric content meaning that they are very good sources of energy and so can provide the body with required energy for metabolic processes. The crude lipid content was observed to range from 2.97% for *Allium cepa* to 25.57% for *Parkia biglobosa. Monodora myristica* is 17.43% which is significantly different from that of *Cuminum cyminum* with 15.90%, *Aframomum melegueta* with 14.83%, *Apium graveolens* and *Ocimum gratissimum* with 13.30 and 12.27% respectively. These values are indicative that the spices contain some fat-soluble vitamins and confers on them their aromatic property. Lipid is also an energy giving nutrient hence its indicative that they provide the body with energy supplements and aid the absorption of fat soluble nutrients. Ash content of a sample represents the mineral content of such sample. Minerals are known to aid the absorption of other essential food nutrients into the blood. *Ocimum* had the highest percentage ash content with 8.67%. *A. cepa* and *A. sativum* had the same value of 4.00% *Xylopia* had 4.83% which was significantly different from *Apium, Pentaclethra and Cuminum* which all had the same value of 3.00%. *Monodora* and *Parkia* had the lowest value 2.50% and 2.00% respectively which were significantly different from others.

Finally, Fibre is important in preventing digestive problems and in return prevent related diseases and complications. *Ocimum* had the highest value of fibre with 11.33%, *Xylopia aethiopica* had the next with 8.00%, *Apium* with 7.00%. Others had significantly lower fibre contents ranging from 2.33% of biglobosa to 6.33% of *Aframomum*. The fibre contents for A. cepa and A sativum is much higher than that obtained by Dalhat *et al*. (2018) which was 0.69% and 0.58%.The proximate analysis result of *Ocimum gratissimum* from this research for carbohydrate, fibre and ash content were in close agreement and between the range of values obtained by Adewole *et al.* (2014), Olumide *et al.* (2019) and Soola *et al.* (2021) but that for protein, moisture and fat content had wide variation. Fat content for this research was 12.27% while theirs were 2.78%, 4,20% and 5% respectively. For protein, the value was relatively lower than theirs with 5.36% compared to 16.51%, 14.35% and 15.40%. These difference in value may be related to factors like the time, place and season of harvest. However, the ash content of 8.67% was higher than 2,45% obtained by Adewole *et al.* (2014) while the other two researchers reviewed obtained 10.50% and 9,1% which is relatedly close. For *Parkia biglobosa,* the fat, ash and fibre contents obtained from this research is in close agreement with the work of Aja *et al.* (2015) and Karay *et al.* (2021). Moisture (3.89%) and protein (35.01% were really lower than theirs but carbohydrate gave a higher value of 31.19% compared to 0.62% and 2.19% from their findings.
The proximate analysis result for *Allium sativum* and *Allium cepa* is basically in contrast with that obtained by Shehu *et al. (*2023) except for the ash content of both and moisture content of *Allium cepa* which were approximately close. For Cumin, the result is in alignment with that of Moawad *et al.*, (2015) for carbohydrate and protein content and also with only the protein from the work of Meena *et al. (*2022) while other parameters show significantly distant values. The result obtained from this study for the percentage crude protein of *Xylopia aethiopica* (8.75%) was higher but within the range of that reported by Ndelekwute and Enyenihi (2018) and Solomon *et al*. (2024) but the values obtained for ash, fibre and moisture contents were lower than the values reported by both researchers**.**

Conclusion
The study showed that the spices selected; *Apium graveolens* (celery), *Ocimum gratissimum* (basil, scent leaf), *Pentaclethra macrophylla* (African Oil Bean), *Aframomum melegueta* (Alligator pepper), *Xylopia aethiopica* (Negro pepper), *Allium cepa* (Onions), *Allium sativum* (garlic) *Cuminum cyminum*(cumin), *Parkia biglobosa* (locust bean) and *Monodora myristica* (calabash nutmeg) recorded considerable significant concentration of proximate components. However, *Allium cepa* and *Xylopia* had the highest percentage of carbohydrates, *Parkia* top the chart for protein followed by *Allium sativum* and *Monodora*. All spice plants had acceptably and favourably low amount of percentage moisture. *Ocimum* had the highest percentage of ash and fibre content while *Parkia* was richest in fat.

Considering the percentage distribution of essential nutrients present in all spice plants analysed, it is suggestive that harnessing these spices in our daily diet could go a long way in enhancing nutrition by improving the immune function, Boosts energy, enhance mental and body health, support growth and development especially with the increasing level of food insecurity. It could also lead to better therapeutic options and dietary recommendations for individuals at risk of chronic disease as the body will be sure of getting all the nutrients it needs to thrive.

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