Sahel Journal of Life Sciences FUDMA (SAJOLS)
March 2025 Vol. 3(1): 87-91
ISSN: 3027-0456 (Print)
ISSN: 1595-5915(Online)
DOI: *https://doi.org/10.33003/sajols-2025-0301-11*

Research Article

Comparative Study of Phytochemicals and Proximate Composition of *Parkia biglobosa, Xylopia aethiopica* and *Aframomum melegueta* for Nutraceutical Applications

***Audu, H.[1], Ajibade, G. A.[2], Dibal, D. M.[2] and Magaji, Y.[3]**

[1]Department of Biology, Federal College of Education, Okene, Kogi State
[2]Department of Biological Sciences, Nigerian Defence Academy, Kaduna
[3]Department of Biotechnology, Nigerian Defence Academy, Kaduna
****Corresponding Author's email*:** hajaraanubeaudu@gmail.com

ABSTRACT

This study was conducted to compare the phytochemical constituents, proximate composition, and concentration of Vitamin C, E, and B carotene of *Aframomum melegueta*, *Xylopia aethiopica,* and *Parkia biglobosa* to determine which spice has the highest antioxidant potential. The methanol extracts of the spice plants were subjected to Phytochemical, Proximate, and Vitamin Screening using Standard Procedures. The results showed that all three selected spices contained tannins, saponins, flavonoids, steroids, and cyanogenic glycosides in varying levels of abundance but differed in the presence of alkaloids. *Parkia biglobosa* contained the highest concentration of Flavonoids (136.74±0.015), *Xylopia aethiopica* contained the highest concentration of Vitamin E (10.30mg/100g and Beta Carotene (11.08mg/100g) which are good sources of antioxidants. *Aframomum melegueta* contained the highest amount of vitamin C (19.10±0.02). *Parkia biglobosa* extract was richest in protein with 35.02% and fat (25.57%) while *Xylopia aethiopica* was found to have a high amount of carbohydrates (63.15%) and the lowest amount of lipid (10.27%) and protein (8.75%). The result showed that the inclusion of these spices in food is highly recommended and even more in a combined form as synergetic functionality will provide the body with the required nutrients and antioxidants for disease prevention as well as the maintenance of good health.

Keywords: Antioxidants; Phytochemicals; Proximate; Spices; Vitamin

Citation: Audu, H., Ajibade, G.A., Dibal, D.M. & Magaji, Y. (2025). Comparative Study of Phytochemicals and Proximate Composition of *Parkia biglobosa, Xylopia aethiopica* and *Aframomum melegueta* for Nutraceutical Applications. *Sahel Journal of Life Sciences FUDMA*, 3(1): 87-91. DOI: *https://doi.org/10.33003/sajols-2025-0301-11*

INTRODUCTION

From ancient times, medicinal plants have been used as source of treatment for man and his animals against various diseases. This medicinal ability of plants is due to the presence of phytochemicals present in different parts of plants. Phytochemicals are legacies of multiple co-evolutionary races between plants and their enemies like pathogens, herbivores and parasites. According to (Sherman and Flaxman, 2001), phytochemicals are chemical cocktails recipes for plants survival. The interest and use of aromatic herbs and spices in our everyday diet is born from the knowledge and fact that they positively affect health in addition to its colour, taste and flavour. These herbs and spices are sometimes used singly or in combination with other ingredients. Herbs and spices have been extensively studied around the world due to the greater demand for their natural food antioxidants which are substances that prevent oxidation of other compounds. (Embuscado, 2015). They could be classified into enzymatic, metabolic, nutrient and synthetic antioxidants. Antioxidants from our diet play an important role in helping endogenous antioxidants for the neutralization of oxidative stress (Lien *et. al.* (2008). Aromatic plants (spices/herbs) provide protein, fibre, volatile components (essential oils),

vitamins, minerals, and phytochemicals and they greatly contribute to the promotion of human health due to their various properties (antioxidant activity, prevention of cancer, cardiovascular and neurodegenerative diseases). The deficiency of nutrient antioxidants is one of the causes of a good number of degenerating diseases today as each nutrient has a unique structure and antioxidant function (Lien *et. al.*, 2008).

Parkia biglobosa is a local condiment native to Africa, Nigeria inclusive. *Parkia biglobosa R. Br* is commonly known as the Locust bean. It belongs to the family Papillonaceae, the Pulp of fruits, Seeds of the tree is used as condiments in soups. Hausa call it Daddawa while it's called Iru in the Yoruba language and Ogiri by the Igbos. *Aframomum melegueta* are the seeds of a perennial, reed-like plant with showy, trumpet-shaped flowers, indigenous to the humid tropical coast of West Africa, from Liberia along the Gulf of Guinea to Nigeria. It belongs to the family Zingiberaceae. Among their other names are Guinea pepper, Melegueta pepper, and Alligator pepper. It is called Chilla in Hausa, ose-orji in Igbo and ataare in Yoruba. The spice, originally brought to Europe in the 13th century via Saharan caravan routes, was appreciated as a substitute for true pepper. Present-day production is still in the same region, with Ghana as the main exporter. (Norman, 2015). *Xylopia aethiopica* on the other hand belongs to the family *Annonaceae*. It is an aromatic pungent spice plant that thrives in evergreen rainforests of tropical and non-tropical Africa. The spice is commonly known as Negro Pepper or grains of Selim. In Nigeria, the Hausa call it" Kimba" the Yoruba's call it "Eeru" while the Igbos call it "Uda". The spice is traditionally known to possess great medicinal use and property (Ayodele *et al*., 2019).

Parkia biglobosa Locust beans*)* | *Xylopia aethiopica* (Negro pepper*)* | *Aframomum melegueta* (Alligator pepper)

Figure 1: Pictorial Representation of the Selected Plants

MATERIALS AND METHODS

Sample Collection

The three spice samples were obtained from the central market, Ahmadu Bello Way, Kaduna. Kaduna State. Samples were transported to the laboratory of the Nigeria Defence Academy, authenticated, pulverized to fine powder and stored in labelled airtight containers before extraction and analysis.

Chemicals and Reagents

All the solvents and chemicals used for extraction and analysis were of analytical grades.

Phytochemical Analysis

The spicy plant extracts were subjected to phytochemical tests for the presence of bioactive compounds like Alkaloids, Flavonoids, Saponins, Tannins and Cyanogenic glycosides by standard methods as described by Odebiyi and Sofowora (1978), and Trease and Evans (1979).

Proximate Analysis

The Spice Samples were analysed for proximate composition for the Total Moisture Content, Crude fibre, Carbohydrate, Ash Content, and Crude protein. These determinations were performed under the Association of Official Analytical Chemistry (AOAC, 2015).

Vitamin Analysis

Adopting Standard Procedures, Equipment like Centrifuge, Test-Tubes Shaker, Water Bath, Shimadzu UV-Vis 2550 Spectrophotometer and Cuvettes, analytical balance, Whatman 541 filter paper and glassware were used to determine the Concentration of Vitamins C, E and B Carotene.

For the Spectrophotometric Measurements, suitable settings were chosen: 2 nm slit width, 1000 nm min-1 scan speed, and very high smoothing.

Statistical Analysis

All data collected were statistically analysed using SPSS. Analysis was carried out in triplicates. Mean and Standard Deviation (SD) for all three samples were determined and presented. ANOVA was used and the difference between the means was compared using the Duncan Multiple Test at a significant level of $p \leq 0.05$.

RESULTS

Result of qualitative phytochemicals analysis of selected spices are presented in Table 1. While saponins, flavonoids, tannins, terpenoids, steroids and cyanogenic glycosides were present in *Aframomum melegueta*. *Xylopia aethiopica* and *Parkia biglobosa,* alkaloids were absent in *Xylopia*

aethiopica but present in *Parkia biglobosa* and *Aframomum melegueta*. Tannins, saponins and alkaloids were found to be strongly present in all three plants. Terpenoids, flavonoids were moderately present while cyanogenic glycosides and steroids were slightly abundant.

Table 2 showed that all three spice plants were rich in flavonoids with *Parkia biglobosa* containing the highest concentration with 136.74 ug/ml of the sample. *Xylopia aethiopica* contained 96.33 ug/ml while *Aframomum melegueta* contained the least concentration with 91.81ug/ml, all values were statistically significant from each other. *Aframomum melegueta* had the highest concentration of tannins (39.56 ug/ml) and terpenoids (17.54 ug/ml). *Xylopia* aethiopica contained the least concentration of tannins (21.56 ug/ml) and terpenoids (12.75 ug/ml) while the concentrations of tannins and terpenoids in *Parkia biglobosa* were 33.33 ug/ml and 13.13 ug/ml. Values not up to that obtained in *Aframomum melegueta* but more than that obtained in *Xylopia aethiopica.* Saponins and cyanogenic glycoside also followed the same pattern as tannins and terpenoids. However, *Parkia biglobosa* was found to contain the highest steroid and alkaloid with 20.78ug/ml and 8.87ug/ml respectively, *Aframomum melegueta was next with* 15.78 ug/ml and 8.48 ug/ml while *Xylopia aethiopica* was contained the least concentration of 12.44ug/ml and 0.00ug/ml since it was absent in the qualitative screening.

From Table 3, *Xylopia aethiopica* contained the highest amount of carbohydrates, percentage ash and percentage crude fibre with values of 63.15%, 4.83% and 8.00% respectively. *Aframomum melegueta* contained the second highest of the three nutrients *while Parkia biglobosa* contained the lowest percentage of carbohydrates (31.19%), percentage of ash (2.00%) and percentage of crude fibre (2.33%). From the results obtained for protein and fat, *Parkia biglobosa* extract was richest in protein (32.02%) and crude fats (25.57%) *Aframomum melegueta* was next with 14.83% protein and 14.01% fat while *Xylopia aethiopica* had 8.75% protein and 10.27% fats. The moisture content for all three plants was between 7.00% (*A. melegueta*) as the highest and 3.89% (*P. biglobosa)* as the lowest. All values for moisture were within the acceptable percentages for plants as agreed by many researchers.

Results in Table 4 showed that *A. melegueta* contained the highest amount of Vitamin C (19.10mg/100g) next was *P. biglobosa (*9.30mg/100g*)* and *Xylopia aethiopica* which had the lowest concentration with 2.70mg/100g. For vitamin E concentration, *Xylopia aethiopica* contained the highest value (10.30mg/100g), closely followed by *P. biglobosa* (9.25mg/100g) and *A. melegueta* contained the least concentration of vitamin E(5.66mg/100g). *Xylopia aethiopica* again had the highest concentration of beta carotene while both *A. melegueta* and *P. biglobosa* had close but statistically significantly different concentrations of 5.52mg/100g and 5.14mg/100g respectively.

Table 1: Qualitative Phytochemical Analysis of Selected Spice Plants

Phytochemicals	***Aframomum melegueta*** **(Alligator pepper)**	***Xylopia aethiopica*** **(Negro pepper)**	***Parkia biglobosa*** **(Locust beans)**
Alkaloids	+++	___	+++
Saponin	+++	+++	+++
Tannin	+++	+++	+++
Terpenoid	++	++	++
Flavonoid	++	++	++
Cyanogenic Glycosides	+	+	+
Steroids	+	+	+

Key:+++: strongly present, ++: Moderately present, +: Slightly present. - : Absent

Table 2: Quantitative Phytochemical Analysis of Selected Spicy plant

Phytochemicals	***Aframomum melegueta*** **(ug/ml)**	***Xylopia aethiopica*** **(ug/ml)**	***Parkia biglobosa*** **ug/ml)**
Alkaloids	8.48±0.010^{b}	0.00±0.00^{a}	8.87±0.010^{c}
Saponin	18.36±0.011^{c}	8.44±0.006^{a}	10.39±0.010^{b}
Tannin	39.56±0.005^{c}	21.56±0.020^{a}	33.33±0.060^{b}
Terpenoid	17.54±0.010^{c}	12.75±0.010^{a}	13.13±0.0050^{b}
Flavonoid	91.81±0.005^{a}	96.33±0.010^{b}	136.74±0.015^{c}
Cyanogenic glycosides	7.49±0.005^{c}	6.57±0.005^{a}	6.96±0.005^{b}
Steroids	15.78±0.005^{b}	12.44±0.010^{a}	20.78±0.010^{c}

Data represented as mean ±SD. Means followed with different superscripts on the same row are significantly different (P≤0.05)

Table 3: Percentage Proximate Composition of Selected Spice plants

Chemical Composition	*Aframomum melegueta*	*Xylopia aethiopica*	*Parkia biglobosa*
Moisture content (%)	7.00±0.01^{c}	5.00±0.11^{b}	3.89±0.01^{a}
Ash content (%)	3.83±0.01^{b}	4.83±0.01^{c}	2.00±0.05^{a}
Crude lipid (%)	14.83±0.01^{b}	10.27±0.02^{a}	25.57±0.01^{c}
Crude protein (%)	14.01±0.01^{b}	8.75±0.01^{a}	35.02±0.01^{c}
Crude fibre (%)	6.33±0.11^{b}	8.00±0.05^{c}	2.33±0.11^{a}
Carbohydrate (%)	53.99±0.05^{b}	63.15±0.01^{c}	31.19±0.02^{a}

Data represented as mean ±SD. Means followed with different superscripts on the same row are significantly different (P≤0.05)

Table 4: Vitamin Constituents of Selected Spice plants

Vitamins	Aframomum melegueta (mg/100)	Xylopia aethiopica (mg/100)	Parkia biglobosa (mg/100)
Beta Carotene	5.52±0.01^{b}	**11.08**±0.01^{c}	5.14±0.05^{a}
C	**19.10**±0.02^{c}	2.70±0.01^{a}	9.30±0.05^{b}
E	5.66±0.01^{a}	**10.30**±0.01^{c}	9.25±0.05^{b}

Data represented as mean ±SD. Means followed with different superscripts on the same row are significantly different (P≤0.05)

DISCUSSION

The physiological activity of medicinal plants can be demonstrated through the extraction of bioactive substances from them. Additionally, it aids pharmacology research that results in the creation of a more powerful medicine with lower toxicity. All three selected spices were rich in alkaloids, Flavonoids and saponins. The presence of these phytochemicals is likely to confer on them medicinal properties like antibacterial, anticancer, stimulants, antimalarial agents, anaesthetics, antihypertension agents, antispasmodics, vasodilators, antiasthma and cardiac arrhythmia. Cyanogenic glycosides were found to be absent in both *A. melegueta* and *P. biglobosa* but present in minute quantity in *X. aethiopica*. This is an indication that there will be less toxic degradation of the spices which could be harmful to the body. Flavonoids are known for their antioxidant, anti-inflammatory, anti-cancer, anti-allergic, and anti-viral health benefits (Shehu *et al*., 2023). *P. biglobosa* showed the highest concentration of flavonoids and moderate concentration of tannins and terpenoids supporting its antioxidant properties of scavenging free radicals and inhibiting oxidation. The result of the phytochemical composition of *X. aethiopica* agrees with that obtained by Erhirhie and Moke (2014).

The result of the proximate analysis indicates that while all three spices had a significant amount of protein, fats, ash, carbohydrate and moisture, *P. biglobosa* was richest in protein and lipid and lowest in moisture content. This is an indication that it can be stored for a long time without undergoing spoilage. The result for crude lipid, Ash and protein is related to the work of Ademola *et al.* (2011) and Ajegena *et al*. (2020) but differed greatly in moisture and carbohydrate concentration which was far lower than theirs. This may be linked to the environmental condition of the *P. biglobosa* before purchase. The ash content of the three spices is an indication that they contain macro and micro nutrients which are essential for the maintenance of health. *X. aethiopica* contained the highest percentage of carbohydrates, ash and fibre, indicating that it is a good source of energy and rich in minerals to support good health while *A. melegueta* contained the highest amount of moisture. Bouquaye *et al.* (2017) carried out a similar work using spices in Ghana and from their findings, the percentage of fat and protein for *P. biglobosa* and X. *aethiopica,* percentage of protein and carbohydrate for *A. melegueta* were similar to that of obtained in this work. However, the ash, fibre and moisture contents of *P. biglobosa* and *A. melegueta* differed greatly probably due to differences in sources.

CONCLUSION

Xylopia aethiopica had the highest concentration of beta carotene and Vitamin E with others containing significantly close concentration to *X. aethiopica* while *A. melegueta* had the highest concentration of Vitamin C. *X. aethiopica* and *P. biglobosa* showed more significant differences in the proximate composition while *A. melegueta* and *P. biglobosa* showed a more significant difference with the quantitative phytochemicals determined, especially flavonoids and tannins. These nutrients will confer on them the antioxidant property of protecting the body cells from the effect of molecular damage caused by free radicals. flavonoid is the most dominant component which is known to play enzyme modulator roles in addition

to its antioxidant, anti-inflammatory and antibacterial properties.

Several degenerative diseases are caused by oxidative stress and free radicals that are formed due to diet and lifestyle. Antioxidant therapy is a promising path for prevention and treatment of these diseases. Since each of the spices has some significant and beneficial phytochemicals, and proximate and vitamin concentrations, their use as natural condiments and additives in food is highly recommended and even more in a combined form as synergetic functionality will provide the body with the required nutrients and antioxidants for disease prevention as well as the maintenance of health.

REFERENCES

Ademola, I. T., Baiyewu, R.A., Adekunle, E. A., Omidiran, M. B. and Adebawo, F. G. (2011). An Assessment into Physical and Proximate Analysis of Processed Locust Bean (Parkia biglobosa) Preserved with Common Salt *Pakistan Journal of Nutrition* 10 (5): 405-408, ISSN 1680-5194.

Ajegena, Y S., Atara, J. G, Emgba, K. S. (2020).Proximate Analysis of Fermented and Unfermented African Locust Beans (Parkia Biglobosa), Found in Lafia, Nasarawa State, Nigeria. *International Journal of Research and Scientific Innovation* (IJRSI) | Volume VII, Issue X, October 2020 | ISSN 2321–2705 pg235-236.

Association of Official Analytical Chemistry (2005). AOAC. Official Method of Analysis. Washington DC pp 205-610.

Ayodele, P. F., Ore, A. and Akinloye, O. A. (2019). Median Lethality Dose of Xylopia aethiopica Fruit Ethanol Extract. *J. Anal Tech Res*; 1(1): 033-036

Benzanowska-Kope, R. and Piatkowska, E. (2022). Total Polyphenols and Antioxidant Properties of Selected Fresh and Dried Herbs and Spices. *Appl. Sci.*,12:4876.https://doi.org/10.3390/app12104876

Biswas, A. K., Sahoo, J., and Chatli, M. K. (2011). A simple UV-Vis spectrophotometric method for determination of β-carotene content in raw carrot, sweet potato and supplemented chicken meat nuggets. LWT-Food Science and Technology, 44(8), 1809-1813.

Borquaye, L. S., Darko, G, Laryea, M. K, Gasu, E. N, Ampawah, N. A. and Appiah, E. N. (2017). Nutritional and anti-Nutritional Profiles of some Ghanaian spices. *Cogent Foods and Agriculture; 3:1348185,* 1-12.

Chung, K. T., Wong, T. Y., Wei, C. I., Huang, Y. W. and Lin, Y. (1998). *Review of food science and Nutrition,* 38(6):421-64.

Embuscado, M.E. (2015). Spices and herbs: Natural sources of antioxidants- a mini-review. Journal of Functional Foods; 10(18), 811-819.

Erhirhie, E. O. and Moke, G. E. (2014). *Xylopia aethiopica*: A Review of its Ethnomedicinal, Chemical and Pharmacological Properties. A*merican Journal of PharmTech Research*: 4(6):22-36.

Hussein, A. Z. M. (2013). Spectrophotometric Determination of Ascorbic acid in Aqueous Solutions and in pharmaceutical formulations*. Al-Nahrain Journal of Science, 16*(3), 65-71.

Kumar, A. & Rajput, G. K. (2011). To Develop a Simple (UV-VIS Spectrometric) Method for the Estimation of Multivitamins with Special Reference to Capsules & Tablets. 2(1) pp. 43-48

Lien Ai pham-Hug, Hua He and Chuong pham-Hug (2008). Free Radicals, Antioxidants in Disease and Health. *Int J Biomed Sci* 4(2); 89-96. PMC3614697)

Norman, J. (2015). Herbs & Spices: *Aframomum melegueta* Penguin Random House. Page 219.

Olalude, C.B., Adegboyega, A.M., Bamigboye, A.Y., Abiona, D. L., Anifowose, O. A., et al (2021). Proximate analysis and mineral content determination of traditionally processed locust bean (*Parkia biglobosa*) fruit pulp for possible industrial application *Edelweiss Chem Sci J* 4: 10-13.

Odebiyi, O. O. and Sofowora, E. A. (1978). Phytochemical Screening of Nigeria medicinal plants. *Lloydia* 4: 234.

Sherman, P. W. and Flaxman, S. M. (2001). Protecting ourselves from food: Spices and morning sickness may shield us from toxins and microorganisms in the diet. American Scientist: *JSTOR*, 89(2), 142-151.

Trease, G. E. and Evans, W. C. (1989). Pharmacognosy. 11th Edition. London: Bailliere Tindall ltd.