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Evaluation of the Antinutritional and Nutritional Composition of Five Nigerian Spices

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Abstract: Spices in Nigeria have been used for the treatment and alleviation of several ailments, therefore the need to evaluate their antinutritional and nutritional properties. Five Nigerian spices were evaluated for their nutritional and antinutritional compositions to ascertain their medicinal values. These spices were the West African black pepper (Piper guineensce), Negro pepper (Xylopia aethiopica), Scent leaf (Ocimum gratissimum), Castor plant (Ricinus communis) and Hariknot plant (Pergularia deamia). The crude were extracted using standard methods and subjected to phytochemical screening. The results indicated the presence of Alkaloids, Flavonoids, Tannins, Phenols and Steroids. Cardiac Glycosides and Terpenoids were present in Piper guineense, Xylopia aethiopica and Ocimum gratissimum, but absent in Recinus communis and Pergularia deamia. Resin was present in Xylopia aethiopica but absent in the other four extracts. Saponins was present in Piper guineense, Ocimmum gratissimum, Pergularia daemia and Ricinus communis, but absent in Xylopia aethiopica. Proximate analysis result revealed a percentage moisture content of 9.20±0.03% in Piper guineense, 8.80±1.10% in Xylopia aethiopica, 11.90±0.01% in Ocimum gratissimum, 6.90±0.02% in Ricinus communis and 8.80±0.03% Pergularia deamia, percentage ash (1.12±0.04 to 3.46±0.03%), percentage crude fat (2.80±0.03 to 48.16±0.02%), percentage crude fibre (13.00±0.09 to 15.50±0.55%), percentage crude protein (4.81±0.02 to 14.43±0.12%), total percentage carbohydrate (19.38±0.10 to 67.10±0.04%). The Vitamin analysis indicated that, Vitamin A (54.99±0.02 to 94.54±0.11 mg/100g), Vitamin C (1.32±0.36 to 4.97±0.03 mg/100g), and Vitamin E (2.27±0.81 to 5.18±0.03 mg/100g). The elemental analysis showed that Calcium (378.95±0.10 to 6,710.53±0.10 mg/kg), Potassium (400.00±0.32 to 3,000.00±0.32 mg/kg), Manganese (46.32±0.32 to 219.65±0.23 mg/kg), Iron (127.63±0.02 to 417.60±0.04 mg/kg), Zinc (15.71±0.28 to 21.08±0.12 mg/kg). Lead (5.90±0.05 to 11.84±0.02 mg/kg), Nickel (18.46±0.32 to 99.23±0.18 mg/kg), Cadmium (0.41±0.12 to 1.13±0.23 mg/kg), Chromium (2.47±0.09 to 13.37±0.53 mg/kg), Arsenic (0.00 to 16.67±0.45 mg/kg). The nutritional composition of these spices has testify that they can be used successfully as supplements in diets as well as component of pharmaceutical drugs for the treatment and alleviation of common health challenges. The use of these spices is therefore highly recommended in our daily diets.

Keywords: Antinutritonal, Nutritional, Nigerian Spices and Composition

1. Introduction

Spices are defined as plant matter, usually dried, used to season or flavour food. [1]. Spices can also be dried seeds, flowers, fruits, barks, roots, leaves of plants or vegetative substances of different plants used in small quantities as food additives [2] and at the same time, serve as dietary supplements [3]. Spices can improve the palatability, enhance flavour and visual appearance of dull diets.

Piquant flavours are valued for other properties like stimulation of appetite, carminative and anti-oxidant effects and promotion of digestion [2]. Some chemical food additives however, have adverse side effects on human

health [4]. Research has shown that deterioration of human health may correlate with food products and food additives [4]. Even though spices are not eaten as real functional foods but as supplements, its nutritional capacity should not be neglected. They are important sources of proteins, carbohydrates, vitamins, minerals, fats and oils, and therefore contribute to the nutritional enrichment of food in their own little way. Spices possess anti-inflammatory, antibacterial and antioxidant properties, and it also reduces cholesterol levels which help to prevent heart diseases [5]. Medicinal plants are sources of raw materials for pharmaceutical drug formulation [6]. A significant percentage of medicinal plants used by the rural populace in Africa are affordable when compared to the high cost of conventional drugs. In the rural communities, people depend mostly on traditional medicine which also recognizes their socio-cultural and religious background which orthodox medicine neglects [7]. Medicinal plants contain numerous biologically active compounds such as vitamins, minerals and phytochemicals which have physiological actions on the human body and these inherent active ingredients are used to treat various ailments [8]. Majority of the world's population in developing countries still relies on herbal medicines to meet their health needs [9].

1.1. West Africa Black Pepper (Piper Guineense)

In Nigeria, *Piper guineense* is referred to as Uziza (Igbo), Iyere (Yoruba), and Masoro (Hausa).

Figure 1. *Piper guineense Leaves.*

Piper guineense has so many uses including culinary, medicinal, cosmetic and insecticidal uses [10]. In traditional herbal medicine; seeds are put into a variety of uses. In some part of Nigeria, seeds are consumed by women after childbirth, to enhance uterine contraction for expulsion of the placenta and other remains from the womb [11]. It is added to food of lactating mothers, during postpartum period, as it is claimed that it encourages or stimulates uterine contractions, therefore, aiding in the fast return of uterine muscle to the original shape [12].

1.2. Negro Pepper (Xylopia Aethiopica)

Xylopia aethiopica is known as Negro pepper in English, Uda (Igbo), eru (Yoruba) and kimbara (Hausa).

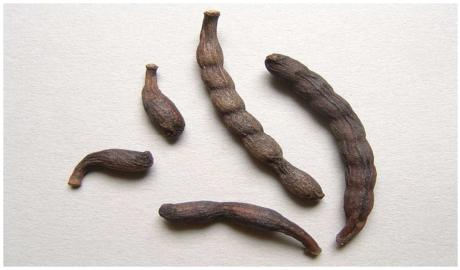

Figure 2. *Dried seeds of Xylopia aethiopica.*

Xylopia aethiopica when used in combination with other nutritious regimen like fruits, fish and legumes, may be a promising option for the effective management of sickle cell disease [13]. It is taken to encourage fertility and to ease childbirth. When crushed, *Xylopia aethiopica* is rubbed on the forehead to treat headache and neuralgia. Mixture of *Xylopia aethiopica* with salt serves as a cure for constipation (14).

1.3. Scent Leaf (Ocimum Gratissimum)

Ocimum gratissimum is referred to as scent leaf around the world, Nchuanwu (Igbo), Diadoyal (Hausa) and Efinrin (Yoruba), Niosh in Gamai.

Figure 3. *Leaves of Ocimmum gratissimum.*

Ocimum gratissimum is used throughout West Africa as anti-malarial and anti-convulsant. The crushed leaf juice is used in the treatment of convulsion, stomach pain and catarrh. Oil from the leaves have been found to possess antiseptics, antibacterial and antifungal activities [15].

1.4. Castor Oil Plant (Ricinus Comunis)

Ricinus communis is known as Castor oil (seed) around the world, Ogiri-okpei (Igbo), Cika-gadaa (Hausa), Ilara (Yoruba).

Figure 4. *Ricinus communis Plant.*

The residue from the seed of *Ricinus communis* can either be used as fertilizer component after extracting oil from the seed or cooked to destroy toxin and incorporated into animal feeds. [16]. *Ricinus communis* is the primary source of oil which can be used both as herbal medicine as well as a conventional therapy for various ailments [17]. The roots are also use by the Gamai people as a cure for some veneral disease like gonorrhea and sylphilis. [18]

1.5. Hariknot Plant (Pergularia Daemia)

Pergularia daemia is called Hariknot plant around the world, Utazi in Igbo, Teji in Yoruba.

Figure 5. *Pergularia daemia Leaves.*

2. Materials and Methods

2.1. Sample Collection and Identification

The fresh leaves/seeds of *Piper guineensce (Africa black pepper)*, *Ocimum gratissimum* (Scent leaf), *Ricinus communis (Castor Plant)* and *Xylopia aethiopica* (Africa pepper) were obtained from Chorbe Market, in Jos North Local Government Area of Plateau State, Nigeria in May, 2018. He Scientific identification was done by Herbarium Department, Federal College of Forestry Jos, Plateau state.

2.2. Sample Preparation

The samples were washed thoroughly, to remove dirt and prevent microbial contamination; air dried for three weeks, under shade in the laboratory and each was pulverized separately into powdered form and stored in an airtight plastic container at room temperature for further analysis.

2.3. Preparation of Plant Extract

Aqueous extracts of the spices were prepared by soaking the dry powdered plant in water then filtered with Whatman filter paper, the filtrate was used for phytochemical analysis.

2.4. Phytochemical Analysis

Phytochemical screening was carried out using standard procedures to identify the minor and major phytochemical constituents present in the plant extracts.

Alkaloid, Flavonoids, Tannins, Saponins, Phenols, Glycosides were determined using the official methods of analysis of the Association of Official Analytical Chemists [19]. Carbohydrate was determined by the Molisch's Test, Fats and Oil, Steroids, Terpenoids were determined using standard methods.

2.5. Proximate Analysis

The proximate analyses for the samples of these five spices were carried out using the official methods of analysis of the Association of Official Analytical Chemists [19] and replicated three times. Moisture Content, Ash Content, Crude Lipid, Crude Fibre, Crude Protein, and carbohydrate content was obtained as follows:

$$\%\text{Total Carbohydrate}=100 - (\%\text{Moisture} + \%\text{ Ash} + \%\text{ Protein} + \%\text{ Fat})$$

2.6. Vitamin Analysis

The vitamins in the Spices were determined by the official methods of the Association of Official Analytical Chemists (19). Vitamins A (Retinol), Vitamin C (Ascorbic acid), Vitamin E (Tocopherol), were all determine using this standard procedure. [19].

2.7. Mineral Analysis

About 5g of the dried powered sample was weighed into a crucible and gently heated over a hot plate until it I was charred. The charred sample, with the crucible were transferred into a muffle furnace and the temperature of the furnace was raised to about 550°C, the sample was allowed to stay in the furnace for about 5hours, until grayish white ash was obtained. It was allowed to cool at room temperature and then transferred to desiccators. $5cm^3$ of concentrated HCl/HNO_3 in the ratio of 1:3 was added to the ash and heated on a hot plate inside a fume cupboard until the volume reduced to $2cm^3$. The mixture was allowed to cool, then transferred into a beaker and the crucible was washed several times with deionized water. The mixture was filtered into a $100cm^3$ volumetric flask using No. 1 Whatman filter paper and made up to the mark. The minerals/heavy metals; Potassium, Calcium, Magnesium, Zinc, Manganese, Arsenic, Cadmium, Lead, Chromium, Nickel, were determined, using air acetylene flame, Atomic Absorption Spectrophotometry (BUCK Scientific, Model 200A). Glassware used for analyses were thoroughly cleaned and all reagents were of analytical grade.

3. Results

The results of the phytochemical screening of the five spices; *Piper guineense, Xylopia aethiopica, Ocimum gratissimum*, *Recinus communis* and *Pergularia daemia* is presented in Table 1.

Table 1. *Result for the Phytochemical Screening of Piper guineense, Xylopia aethiopica, Ocimum gratisimum, Ricinus communis and Pergularia daemia.*

Test	*Piper guineense*	*Xylopia aethiopica*	*Ocimum gratisimum*	*Ricinus communis*	*Pergularia daemia*
Alkaloids	+	+	+	+	+
Flavonoids	+	+	+	+	+
Tanins	+	+	+	+	+
Saponins	+	-	+	+	+
Phenol	+	+	+	+	+
Cardiac glycosides	+	+	+	-	-
Steroids	+	+	+	+	+
Terpenoids	+	+	+	-	-
Resin	-	+	-	-	-

(+) indicates present, while (-) indicates absent

Table 2. *Proximate Composition of Piper guineense, Xylopia aethiopica, Ocimum gratissimum, Ricinus communis and Pergularia deamia.*

Proximate	*Piper guineense*	*Xylopia aethiopica*	*Ocimum gratissimum*	*Ricinus communis*	*Pergularia deamia*
Moisture Content%	9.20±003	8.80±1.10	11.90±0.01	6.90±0.02	8.80±0.03
Ash Content%	2.59±0.04	3.23±0.05	3.46±0.03	1.12±0.04	2.20±0.04
Crude Lipid%	2.80±0.03	18.00±0.70	3.67±0.07	48.16±0.02	6.82±0.10
Crude Fiber%	13.50±0.02	15.50±0.55	13.00±0.09	13.50±0.02	14.00±0.10
Crude Protein%	4.81±0.02	4.38±0.25	14.43±0.12	10.90±0.09	6.50±0.02
Total Carbohydrate%	67.10±0.04	50.09±0.08	53.54±0.08	19.38±0.10	61.68±0.01

Mean±S. D, n=3

Table 3. *Vitamin A, C and E composition of Piper guineense, Xylopia aethiopica, Ocimum gratissimum, Ricinus communis and Pergularia deamia.*

Nutrient (mg/100g)	*Piper guineense*	*Xylopia aethiopica*	*Ocimum gratissimum*	*Ricinus communis*	*Pergularia deamia*
Vitamin A	64.82±1.17	54.99±0.02	74.54±0.55	94.54±0.11	58.28±0.57
Vitamin C	2.32±0.24	4.97±0.03	1.59±0.04	1.32±0.36	3.52±0.28
Vitamin E	4.14±0.03	5.18±0.03	2.27±0.08	2.12±0.04	3.59±0.04

Mean±S. D, n=3

Table 4. *Minerals and Heavy Metals Composition of Piper guineense, Xylopia aethiopica, Ocimum gratissimum, Ricinus communis and Pergularia deamia.*

Mineral (mg/kg)	*Piper Guineense*	*Xylopia aethiopica*	*Ocimum gratissimum*	*Ricinus communis*	*Pergularia deamia*
Calcium	1,568.40±0.56	378.95±0.10	6,710.53±0.09	1,021.05±0.06	6105.30±0.01
Potassium	2142.00±0.10	1714.00±0.21	3000.00±0.32	400.00±0.32	3000.00±0.01
Manganese	46.32±0.32	95.09±0.10	81.05±0.76	103.16±0.11	219.65±0.23
Zinc	16.41±0.11	15.71±0.28	20.23±0.93	20.78±0.12	21.08±0.14
Iron	344.74±0.26	236.70±0.31	181.42±0.09	417.60±0.04	127.63±0.02
Lead	10.61±0.74	11.02±0.11	11.84±0.12	5.90±0.04	6.12±0.17
Cadmium	0.41±0.12	0.65±0.23	0.97±0.26	0.49±0.03	1.13±0.23
Chromium	11.87±0.33	2.47±0.09	11.83±0.12	11.31±0.03	13.37±0.53
Nickel	43.08±0.70	18.46±0.32	99.23±0.18	91.92±0.03	76.92±0.12
Arsenic	11.33±0.10	12.67±0.64	8.00±0.12	N. D	16.67±0.45

Mean±S. D, n=3, N. D=Not Detectable

4. Discussion

This study showed the major phytochemicals, proximate, vitamin, mineral and heavy metal contents in *Piper guineense, Xylopia aethiopica, Ocimmum* gratissimum, *Pergularia daemia* and *Ricinus communis* commonly used in South Eastern Nigeria.

Table 1 presents the major phytochemical components present in the aqueous extracts of the samples. The result indicate the presences of Alkaloids, Flavonoids, Tannins, Phenols and Steroids in all of the plant extracts. Cardiac Glycosides and Terpenoids were present in *Piper guineense, Xylopia aethiopica* and *Ocimum gratissimum*. Resin was present in *Xylopia aethiopica* but absent in the other four extracts. Saponins was present in *Piper guineense, Ocimmum* gratissimum, *Pergularia daemia* and *Ricinus communis*, but absent in *Xylopia aethiopica.*

The proximate composition (Table 2) indicated that *Ocimmum gratissimum* (11.90%) and *Piper guineense* (9.20%) are having the highest moisture contents when compared to the other samples, which implied that they both have a short shelf life and are susceptible to microbial growth. According to Agomuo *et al.,(*2011) [20] low moisture content of Plant sample is an indication of the fact that the plant can be stored for a long period without deterioration in quality. The ash content of *Ocimum gratissimum* (3.46%) is high compared to the other spices implying that it has high mineral content, hence very nutritious.

High ash content is not necessarily a conclusive factor regarding the health benefits of plants. *Piper guineense*

(2.80%) and *Ocimmum gratissimum (*3.67%) contain small amount of crude lipid, therefore, could be recommended as part of weight reducing diets since low fatty foods are said to reduce the level of cholesterol and obesity. Igile *et al*., (2013) (21) reported that low fat content correlates directly with the low total fatty acid content. The crude fibre content of *Xylopia aethiopica* is the highest (15.50%) compared with the other four spices which are equally having considerable amount of crude fiber. According to Igile *et al*., (2013) [21] consumption of plants which contain fiber could aid digestion, absorption of water from the body and prevent constipation. The protein content of the spices was found to be moderately low in *Pergularia daemia* (6.50%), *Xylopia aethiopica* (4.81%), *Piper guineense (4.38%),* and moderately available in *Ricinus communis* (10.94%) and *Ocimmum gratissimum* (14.43%). Protein is vital for various body functions such as body development, maintenance of fluid balance, formation of hormones, enzymes and sustaining strong immune function [22]. The carbohydrate content in these spices comparatively high in *Piper guineense* (67.10%) and *Pergularia daemia* (61.68%), moderate in *Xylopia aethiopica* (50.50%) and *Ocimmum gratissimum* (53.54%), but low in *Ricinus communis* (19.38%), making them good sources of carbohydrate. Carbohydrates are required for energy in the body [23] and supplies energy to cells such as brain, muscle and blood [23].

The vitamin A content of the spices ranged from 54.99 mg/kg in *Ricinus communis* to 94.54 mg/kg in *Xylopia aethiopica*. Vitamin C content of *Piper guineense, Xylopia aethiopica, Ocimmum gratissimum*, *Pergularia daemia* and *Ricinus communis* were 2.32 mg/kg, 4.97 mg/kg, 2.27 mg/kg, 3.52 mg/kg and 1.32mg/kg respectively. Vitamin E content varied from 2.12 mg/kg to 5.18 mg/kg in *Ricinus communis* and *Xylopia aethiopica* respectively.

The Calcium, Potassium, Manganese, Iron and Zinc content were higher when compared with standard recommended dietary allowance (RDA). The content of Calcium ranged from 378.95mg/kg to 6710.53 mg/kg. The Potassium content varied from 400.00 to 3000.00mg/kg in Ricinus *communis* and *Ocimmum gratissimum* respectively, whereas *Ocimmum gratissimum* and *Pergularia deamia* had the same value of 3000.00mg/kg. The Iron content ranged from 127.63 to 417.60 mg/kg in *Pergularia deamia* and *Recinus communis* respectively. The content of Zinc ranged from 15.71 to 21.08 mg/kg in *Xylopia aethiopica* and *Pergularia deamia* respectively. The manganese content varied from 46.32 to 219.65 mg/kg in *Piper guineense* and *Pergularia deamia* respectively. The concentrations of Iron and Manganese in these spices were significantly higher than the values reported for some green leafy vegetables, such as *Ficus capensis, Solanum melongena, Mucuna pruriens, Solanum macrocarpon, Solanum nigrum, Moringa oleifera, Solanum aethiopicum* and *Cridoscolus acontifolius* [24].

The concentrations of the toxic metals ranged between 0.00 to 16.670 mg/ kg for Arsenic, 0.41 to 1.34mg/kg for Cadmium, 11.31 to 13.37mg/kg for Chromium, 18.46 to 99.23 mg/ kg for Nickel, 5.90 and 11.89mg/kg for Lead.

The elemental concentration reported herein might not be at par with some of the earlier reports on these spices/plants. The differences observed might be due to different growth conditions, genetic factors, geographical variations in the level of soil fertility, efficiency of mineral uptake, and the analytical procedure employed. Though much is known about the functional role of a number of elements, the best foreseeable benefit for human health, by mineral nutrition, lies in obtaining the correct amount of supplementation in the right form at the right time.

5. Conclusion

This study has shown that these spices are very rich in basic food nutrients. The phytochemical study revealed the presence of Alkaloids, Flavonoids, Tannins, Phenols and Steroids in all of the plant extracts. Cardiac glycosides and Terpenoids were present in *Piper guineense, Xylopia aethiopica* and *Ocimum gratissimum, absent in Recinus communis and Pergularia deamia*. Resin was present in *Xylopia aethiopica* but absent in the others. Saponin were present in *Piper guineense, Ocimmum* gratissimum, *Pergularia daemia* and *Ricinus communis*, but absent in *Xylopia aethiopica*. The presence of phytocompounds in these plants, therefore, supports the traditional use of these spices in the management of various diseases.

The results obtained from this study indicated that these spices are good raw material for the production of some medicinal drugs and can be used in folk medicine for the treatment and prevention of some diseases.

It is therefore recommended that further studies on the methods of efficient processing and detoxification of these plants be carried out to enable full utilization of all their parts as alternative to conventional food stuffs.

Conflict of Interest Statement

All the authors do not have any possible conflicts of interest.

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