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A COMPARATIVE STUDY OF THE PHYTOCHEMICAL CONSTITUENTS, PROXIMATE AND MINERAL COMPOSITIONS OF *Zingiber officinale, Curcuma longa, Aframomum sceptrum* and *Monodora myristica*

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ABSTRACT
The phytochemical, proximate and mineral compositions of *Zingiber officinale* (Ginger), *Curcuma longa* (Turmeric), *Aframomum sceptrum* (Bear berry) and *Monodora myristica* (African nutmeg) were investigated. Standard qualitative phytochemical screening, proximate and mineral analyses of the samples were carried out using in vitro methods. The results showed that both the *Zingiber officinale* and *Curcuma longa* had similar phytochemical constituents while *Aframomum sceptrum* and *Monodora myristica* showing slight variation. Alkaloids, flavonoids, phenols were highly positive (+++) in all samples studied but *Z. officinale* and *C. longa* showed higher contents of glycosides, tannins, saponins and anthraquinones than *A. sceptrum* and *M. myristica.* Crude protein, crude fat, crude fibre, ash, moisture and carbohydrate contents of *A. sceptrum* and *M. myristica* were similar (10.23 -10.58%, 3.17 – 3.19%, 20.40 – 20.45%, 48.76 – 49.56%, 8.72 – 8.81% and 8.72 – 7.41%) respectively and much higher than the values obtained from *Z. officinale* and *C. longa* (5.47 -5.55%, 2.05 – 2.03%, 10.39 – 10.36%, 5.99 – 5.87%, 55.62 – 55.84% and 20.48 – 20.35%). Values of mineral compositions observed in all samples were relatively high with those of *A. sceptrum* and *M. myristica* being 50% higher than *Z. officinale* and *C. longa* with the exception of sodium which was similar in all samples studied (0.27 – 0.28 mg/100g).

Keywords: Phytochemical constituents, proximate and mineral compositions, *Z. officinale, C. longa, A. sceptrum* and *M. myristica*

Introduction

Zingiber officinale (Ginger) belongs to the family of Zingiberaceae. The characteristic pungent flavor of ginger is due to the presence of volatile essential oils (1 – 3%) and oleoresins (4 – 7%). Other active components of ginger include gingerol, α-zingiberene, shogaol, α-curcumene, β-sesquiphellandrene (Ogbuewu *et al.*, 2014). Ginger possesses some therapeutic properties due to its myriad of secondary metabolites such as antioxidant, antimicrobial, anti-inflammatory, anticancer, glucose and cholesterol lowering (Shukla and Singh, 2007; Aryaeian and Tavakkoli, 2015). *Curcuma longa* (Turmeric) is a perennial monocotyledonous herbaceous plant that belongs to the family of Zingiberaceae. Turmeric rhizome is bitter and pungent. It contains beta-carotene, ascorbic acid (vitamin C), flavonoids, fibre, calcium, iron, zinc, potassium and other nutrients. The basic ingredient in turmeric is curcumin, a yellow active ingredient. Turmeric is widely used in household remedies for the treatment of wounds, eczema, stomach pains, menstrual disorder, diabetes, high cholesterolemia, inflammations, peptic ulcer, cancer (Gopinathan *et al.*, 2011; Olatunde *et al.*, 2014).

Aframomum sceptrum (bear berry) is a terrestrial rhizomal herb that belongs to the family Zingiberaceae. They are aromatic and pungent. The major classes of compounds found in *A. sceptrum* include diterpenoids, flavonoids and alkaloids (Tane *et al.*, 2000). Extracts and compounds of this genus possess several biological activities such as antioxidant, antidiabetic, antifungal, cytotoxic, antibacterial, insect antifeedant, antihypercholesterolemic, anti-inflammatory and antiviral activities (Maity *et al.*, 2009; Nwankwo, 2015). They are efficacious in the treatment of venereal diseases, small pox, chicken pox, measles; they act as vermifuges (Cousins and Huffman, 2002) and as febrifuges (George *et al.*, 2012). In food industries, *A. sceptrum* seeds are used as condiment spices and flavourings. Their leaves are crushed and used either as drinks or foods.

Monodora myristica (African nutmeg) belongs to the family Annonaceae. The seeds consist of essential oils (5 – 9%) made up largely of terpenoids with a pleasant taste and smell and reddish brown oil (35 – 37%) which consists mainly of linoleic acid (47%) and oleic acid (35%). The seeds are aromatic and are used after ground into powder as a condiment in food providing a flavor resembling that of nutmeg. As medicine, they are useful as pain-killers and in the treatment and management of diabetes, hyperlipidemia (Nwankwo, 2015), arthritis, rheumatism, stomach ache, hemorrhoids, subcutaneous parasitic infections, febrifuges (Brewer, 2011; Causey *et al.,* 2000).

Materials and Methods

Sources of the materials: *Zingiber officinale* and *Curcuma longa* rhizomes were obtained from the ginger and turmeric farms in NRCRI, Umudike. The *A. sceptrum* and *M. myristica* seeds were obtained from the local market in Umuahia, Abia State.

Preparation of samples: *Z. officinale* and *C. longa* rhizomes were carefully washed (separately), sun-dried for 2 days and cut into pieces. Seeds of *A. sceptrum* and *M. myristica* were also sun - dried for 2 days. All dried samples were pulverized into powder with electric blender. The powdered samples were then used for phytochemical screening, proximate and mineral composition investigations.

Determination of proximate composition: The ash, moisture, crude fibre, crude fat contents of the samples was determined according to the standard method of AOAC, (1990). Crude protein (N X 6.25) was determined by the Kjeldahl method as described by Okalebo *et al*, (2002). Carbohydrate content was obtained by difference. The caloric value of each sample was calculated using Atwater factor method (4 X Carbohydrate) + (4 X Protein) + (9 X Crude fat).

Determination of mineral composition: The mineral content of the samples was determined using the method of Shahidi *et al,* (1999) with slight modifications. Total phosphorus was obtained using the ascorbic acid blue color procedure of Okalebo *et al,* (2002).

Phytochemical screening: Fifteen (15g) grams of each of the powdered samples was extracted in 30ml of ethanol (95%) for 24 hours at room temperature on a flask shaker and filtered with Whatman No.1 filter paper. The filtrates obtained were used to screen for secondary metabolite constituents of the four samples. Phytochemical screening of the four samples was carried out using standard phytochemical qualitative analyses as described by Trease and Evans, (2002).

Statistical Analysis

Statistical analysis system (SAS)/PC software was used for man separations and standard deviation of data.

Results and Discussion

The results of the proximate compositions of *Z. officinale, C. longa, A. sceptrum* and *M. myristica* are presented in Table 1. The results showed that there is no remarkable difference in the contents of ash, crude protein, crude fat and crude fibre in both the *Z. officinale* and *C. longa*. However, *A. sceptrum* and *M. myristica* showed higher contents in their proximate compositions with *M. myristica* being slightly higher than the *A. sceptrum*. The moisture content of both *Z. officinale* and *C. longa* were much higher than those of *A. sceptrum* and *M. myristica.* This could be attributed to the length of time of sun-drying of the rhizomes. The result of the proximate composition in *Z. officinale* and *C. longa* was of the order crude fibre > ash > crude protein > crude fat while in *A. sceptrum* and *M. myristica* it was ash > crude fibre >crude protein > crude fat. High fibre in all samples investigated showed that they are excellent sources of roughage that aids digestion and would contribute to the reduction in the incidence of certain diseases such as diabetes, colon cancer and various other diseases (Causey *et al.,* 2000). Ash was high in all samples studied. Ash is a measure of total mineral content in a sample, showing that all samples could be of nutritional importance. The results revealed that *Z. officinale* and *C. longa* had higher carbohydrate content than both the *A. sceptrum* and *M. myristica.* However, all samples showed high carbohydrate contents and thus could be a rich source of energy.

The results of the mineral compositions of the four samples investigated are shown in Table 2. All samples are rich in the essential mineral elements determined (potassium, calcium, magnesium, phosphorus, sodium and iron). All samples have equal values of sodium (0.27 – 0.28mg/100g). The ratio of sodium to potassium (Na/K) in the body is of great concern for prevention of high blood pressure. Na/K < one is recommended; and all samples showed ratio less than one. This shows that samples will not promote high blood pressure. Calcium is a major factor for sustaining strong bones and plays dominant role in muscle contraction/ relaxation, blood clotting and aids the absorption of vitamin B_{12}. The magnesium, potassium and calcium contents of samples may be important to patients with soft bone problem, to improve mineralization and reduce bone resorption (Kubinarawa *et al.,* 2007). The iron content present in the samples can help hemoglobin formation and hence recommended for iron deficiency in anemia.

The results of the phytochemical compositions of the samples investigated are shown in Table 3. All the secondary metabolites tested for in the four samples were observed to be present in the samples in varying levels. Phlobatannin which was present in *Z. officinale* and *C. longa* were not detected in both the *A. sceptrum* and *M. myristica*. Flavonoids and flavonol were highly positive for *A. sceptrum* and *M. myristica,* but moderately positive in *Z. officinale* and *C. longa.* Tannins, saponins, anthraquinones, steroids and glycosides were found to be highly positive in both *Z. officinale* and *C. longa.* Phenols and alkaloids were highly positive in all samples studied. The high presence of alkaloids in all samples showed that the plants could be used to alleviate headache associated with hypertension, manage cold, chronic catarrh and migraine (Brewer, 2011). The myriad of secondary metabolites in all samples investigated could be the reason they are recommended for use to alleviate several diseases and body disorders.

Conclusion

Results of this investigation revealed that *Z. officinale, C. longa, A. sceptrum* and *M. myristica* are rich in nutritional constituents examined and thus recommended to be incorporated in our diets for healthy living. Dose- response studies and phytochemical investigations are required in order to isolate, purify, elucidate and explore the mechanism of action of the active ingredients responsible for the antioxidant, anticancer, antimicrobial, anti-inflammatory, antibacterial, etc of the herbal constituents.

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Table 1: Proximate composition (%) of *C. longa, Z. officinale, A. sceptrum & M. myristica*

	C. longa	*Z. officinale*	*A. sceptrum*	*M. myrIstica*
Crude Protein	5.47±0.04	5.55±0.62	10.23±1.15	10.58±1.15
Crude fat	2.05±0.01	2.03±0.01	3.17±1.02	3.19±1.02
Ash	5.99±0.32	5.87±0.15	48.76±0.37	49.56±55
Moisture	55.62±0.02	55.84±0.02	8.72±0.01	8.81±0.02
Carbohydrate	20.48±0.01	20.35±0.01	8.72±0.01	7.41±0.01
Caloric Value	122.25±1.15	121.87±1.25	104.33±1.17	100.67±1.05

***Mean of five determinations ± standard deviation**

Table 2: Mineral composition (mg/100g) of *C. longa, Z. officinale, A. sceptrum & M. myristica*

	C. longa	*Z. officinale*	*A. sceptrum*	*M myrIstica*
Sodium	0.28±0.01	0.28±0.01	0.28±0.01	0.27±0.01
Potassium	2.45±0.01	2.50±0.01	5.34±0.01	5.87±0.01
Magnesium	2.55±0.01	2.61±0.01	5.47±0.04	6.01±0.02
Phosphorus	2.75±0.01	2.35±0.01	4.88±0.01	5.00±0.01
Iron	3.57±0.02	3.56±0.01	3.57±0.02	4.01±0.02

***Mean of five determinations ± standard deviation**

Table 3: Phytochemical constituents of C. longa, Z. officinale, A. sceptrum & M. myristica

	C. longa	*Z. officinale*	*A. sceptrum*	*M. myristica*
Alkaloids	+++	+++	+++	+++
Tannins	+++	+++	+	+
Phlobatannins	++	++	-	-
Saponins	+++	+++	++	++
Flavonoids	++	+++	+++	+++
Flavonol	++	++	+++	+++
Anthraquinones	+++	++	+	-
Steroids	+++	+	+	+
Terpenoids	++	+	++	+++
Phenols	+++	+++	+++	+++
Glycosides	+++	+++	+	+

Key: +++ Highly positive , ++ moderately positive, + slightly positive, - not detected