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NUTRIENTS AND PHYTOCHEMICALS COMPOSITION OF METHANOLIC EXTRACT OF FOUR EDIBLE SPICES COMMONLY USED IN THE PREPARATION OF SOUPS IN SOUTH-WEST NIGERIA

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ABSTRACT
Background: Spices are significant source of micro-nutrients, antioxidants and phytochemicals which are highly beneficial for their therapeutic potentials, maintenance of health and prevention of diseases.
Objective: This study assessed the nutrients and phytochemicals composition of methanolic extract of four edible Spices commonly used in the Preparation of Soups in South-West Nigeria
Materials and methods: Ginger, garlic, turmeric and Curry leaf were purchased from Ojakoko in Owo town and shasha market, Akure, Ondo State respectively. Each of the raw spices were thoroughly sorted, washed and diced and air dried for 48hours and milled into powder with attrition milling machine. Chemical and instrumental analyses were conducted on each spice. Data generated was analysed for means and standard deviation. ANOVA and Duncan's New Multiple Range Test (DNMRT) were used to compared and separate the means respectively. Significant difference was set at $p<0.05$
Results: findings shows that protein (13.3%) and ash (5.26%), and sodium were significantly ($P<0.05$) higher in ginger compare to other spices. Garlic was significantly ($P<0.05$) lower in protein (6.38%) but significantly ($P<0.05$) higher in carbohydrate (73.77g), Ca (183.20mg/100g), Cu (0.53mg/100g), Se10.11mg/100g), Mg(25.25mg/100g), P (153mg/100g) and I (4.40mg/100g) while curry leaf was higher in K 570.53mg/100g. Zn (3.76mg/100g) and Fe (3.33mg/100g) were higher in turmeric. For the phytochemicals, curry leaf was higher in polyphenol (27.18%), flavonoids (7.12%), phytate (1.23%) and saponin (0.35%). Turmeric had the highest alkaloids (60.32%) content and was significantly differ ($P<0.05$) in value from other spices.
Conclusion: This study has established that the selected spices are good sources of micro-nutrients, protein, and phytochemicals, therefore it use should be encouraged.

Keywords: *Spices, micro-nutrients, antioxidant, phytochemicals, protein, selenium*

INTRODUCTION

Spices refer to edible parts of a plant including root, seed, rhizomes, fruit, leaves, flowers, barks and any other vegetative substances used in a very small quantity as food additives to garnish, colour, flavour, preservation and for it medicinal properties (1, 2). Spices and herbs, also known as aromatic plants, are an important group of agricultural commodities being used by many civilizations all over the world. They are significant source of micro-nutrients, antioxidants and phytochemicals which are highly beneficial for their therapeutic potentials, maintenance of good health and prevention of diseases (3). Apart from it nutritional and therapeutic potentials, they also add flavor, taste, and increase shelf life to food (3).

Spices are important food ingredient in the preparation of soup and diet of many Nigerian homes. Soup are usually made by grinding tomatoes, pepper, onions, oil seeds and medicinal leaves boiled with animal products and used in the consuming available dietary staples prepared from root and tubers, cereals and legumes (4, 5). One of the major features of indigenous soups are the generous use of different spices such as garlic, ginger, turmeric, curry leaf, nutmeg(*Monodora myristica*) cinnamon (*Cinnamomum verum*) scent leaf (*Ocimum gratissimum)* and so on. These are not limited to traditional soups only but also in food preparation. Away from their culinary purposes, some of these spices if quantifiably consumed can favourably compete with chemotherapy agent to play a role in human health because of their therapeutic potentials (6, 7). For it medicinal use, many consumers abuses it due to deficits in knowledge on the active ingredients present in them and coupled with the quantity to consumed.

Ginger (*Zingiber officinale Rosc.)*, Garlic (*Allium sativum* L.), Turmeric (*Curcuma longa, linn*) and curry leaf (*Murraya koenigii*) has gain a lot of recognition and distinguished themselves in the family of spices in different culture and traditions as a prophylactic as well as therapeutic medicinal plant. Several recipe composition and nutrients constituent studies on Nigerian traditional dishes and soup have

shown adequate macronutrients content (4, 8). Studies on the impact that spices conferred in enhancing the functional properties of soup, taste, flavour, nutritive values as well as stimulate appetite had been thoroughly researched (4,8). However, there are many spices used in dishes and soup preparation in south west, Nigeria whose nutrient properties is yet to be fully study. Therefore, this study evaluated the nutrients and phytochemicals composition of methanolic extract of four edible spices commonly use in the preparation of soups in South-West Nigeria

MATERIALS AND METHODS

Procurement of Raw Materials

Ginger (*Zingiber officinale Rosc.),* Garlic (*Allium sativum* L.), curry leaf (*Murraya koenigii*) and turmeric (*Curcuma Longa, Linn)* were purchased from Ojakoko in Owo Local Government, while curry leaves was purchased at shasha market, Akure, both in Ondo State.

Production of the spices powder

The spices were thoroughly sorted, washed and diced into smaller pieces and air dry for 48hours. The diced spice (1kg per sample) was further dried at 60^0C in an hot air oven for 1hour to a constant weight; milled separately into a fine powder using attrition milling machine, packaged in air tight containers labeled differently for further analysis.

Preparation of crude extracts:

Fifty gram (50g) of each of the milled spices was soaked in 250ml of methanol for 24 hours. The extract was filtered through a sieve to remove debris. The filtrate was then filtered through filter paper. The final filtrate was evaporated in a water bath at 40°C to get the crude extract as described by Idris et al. (9). The ethanol extract was stored at 4°C for phytochemical analysis.

Determination of Proximate Composition

Sample of each of the spices were conducted in triplicates. The moisture content of the samples was determined using the hot air oven methods as described by AOAC (9). The protein content was evaluated using kjeldahl method of protein analysis (10). The fat content was determined using the Soxhlet extraction method. Ash content was determined by incinerating the samples at 550^0C in a muffle furnace while the crude fibre was evaluated by digesting, boiling, refluxing, drying and ashing according to AOAC (10) and the carbohydrate content was estimated by the difference. The percentage total carbohydrate was estimated to be equal to the sum of percentage moisture, protein, ash and fibre subtracted from 100g. % Carbohydrate = 100-(%protein+% fat+%ash+%moisture)**.**

Calcium, Potassium and Sodium determination

The estimation of calcium, potassium and sodium was done by Flame Photometry method. The ash of each samples obtained was digested by adding 5ml of 2 MHCL to the ash in the crucible and heated to dryness on a heating mantle. Reheated and filtered through whatman No 1 filter paper into a 100ml volumetric flask after the addition of 5ml of 2 MHCL. The concentration of calcium, potassium and Sodium on the Jenway Digital Flame Photometer (PFP7 Model) using the filter corresponding to each mineral element (11).

Determination of Phosphorus

The ash of each sample obtained was treated 2 MHCL solution as described for calcium determination above. About 10ml of the filtrate solution was pipetted into 50ml standard flask and 10ml of vanadate yellow solution was added and the flask was made up to mark with distilled water, stoppered and left for 10 minutes for full yellow development. The concentration of phosphorus was obtained by taking the optical density (OD) or absorbance of the solution on a Spectronic 20 spectrophotometer or colorimeter at a wavelength of 470nm (11).

$$\%\text{Phosphorus} = \frac{\text{Absorbance} \times \text{Slope} \times \text{Dilution factor}}{1000}$$

Determination of Magnesium (Mg), Iron (Fe), Zinc (Zn), Selenium (Se) and Copper (Cu) The digest of the ash of each sample above as obtained in calcium and potassium determination was washed into 100ml volumetric flask with deionized or distilled water and made up to mark. These diluents were aspirated into the Buck 211 Atomic Absorption Spectrophotometer (AAS) through the suction tube. Each of the trace mineral elements was read at their respective wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination (11).

Iodine Contents

The determination of iodine content of the spices was carried out by the method described by Moxon and Dixon (12), following the principle of alkaline incineration. The iodine determination was done by measuring the rate of catalytic destruction of iron thiocyanate by nitrate in the presence of iodine.

Phytochemical Determination

Total Alkaloids was determined gravimetrically as described by Harborne (13). Five gram (5g) of the samples was weighed into 250 ml beaker and 200ml of 10% acetic acid in methanol was added and covered and allowed to stand for 4hrs. Saponin was extracted for 2 hours in reflux condenser containing pure acetone in line with a method described by Sofowora, (14). The total flavonoids content was estimated using

colometric method as described by Chang et al. (15), While Phytate was determined using the method described by McCance- Widdowcon as modified by Wheeler and Ferrel (16)

Statistical Analysis

The IBM SPSS Statistics version 20 software was used to conduct the analysis. The results were expressed as mean ± standard deviation and the test for statistical significance was carried out using one-way analysis of variance (ANOVA). Means was separated using Duncan's New Multiple Range Test (DNMRT) and differences was considered significant at $p<0.05$.

RESULTS

The table 1 below shows proximate composition of turmeric, ginger, curry and garlic**.** The moisture content of the samples varies slightly ranges from (9.20 to 11.41%). Ginger had the highest ash content (5.26%) and significantly ($P<0.05$), different from other samples. In terms fat and crude fibre, curry had the highest value 4.73% and 4.38% for fat and crude respectively. Ginger (13.13%) had the highest protein content while the garlic (6.38%) had the least value.

Table 1: Proximate composition of the spices (Turmeric, Ginger, Curry and Garlic) per 100g dry weight

Proximate (g/100g	Turmeric	Ginger	Curry	Garlic
Moisture (%)	10.48 ± 0.042^{b}	10.63 ± 0.037^{b}	9.20 ± 0.226^{c}	11.41 ± 0.521^{a}
Ash (%)	4.16 ± 0.010^{d}	5.26 ± 0.04^{a}	4.53 ± 0.030^{bc}	4.93 ± 0.630^{b}
Fat (%)	3.82 ± 0.026^{c}	4.50 ± 0.011^{b}	4.73 ± 0.008^{a}	1.23 ± 0.288^{d}
Crude fibre (%)	4.36 ± 0.052^{ab}	3.92 ± 0.302^{c}	4.38 ± 0.005^{a}	2.26 ± 0.062^{d}
Protein (%)	11.59 ± 0.22^{b}	13.13 ± 0.026^{a}	7.85 ± 0.009^{c}	6.38 ± 0.025^{d}
Carbohydrate (%)	65.66 ± 0.095^{c}	62.53 ± 0.103^{d}	69.28 ± 0.015^{b}	73.77 ± 1.331^{a}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same row are statistically not significant at P<0.05

The mineral content of the sample is shown on table 2. Iodine (4.40mg/100g), selenium (10.11mg/100g), Calcium (183.20mg/100g) magnesium (25.25mg/100g), phosphorus (153.15mg/100g) were significantly ($p<0.05$) higher in garlic while Curry had the highest value for potassium 570.53mg/100g. Zinc (3.76mg/100g) and Iron (3.33mg/100g) were higher in turmeric than other spices. Ginger had the highest sodium (35.56mg/100g) content followed by turmeric of Turmeric 28.46mg/100g

Table 2: Mineral composition of the four spices (Turmeric, Ginger, Curry and Garlic) per 100g dry weight

Minerals	Turmeric	Ginger	Curry	Garlic
Na**(mg/100g)**	28.46 ± 0.058^{b}	35.56 ± 0.115^{a}	22.56 ± 0.115^{c}	17.06 ± 0.153^{d}
Ca**(mg/100g)**	181.66 ± 0.153^{b}	72.56 ± 0.057^{d}	95.10 ± 0.100^{c}	183.20 ± 0.100^{a}
K**(mg/100g)**	405.43 ± 0.321^{b}	374.46 ± 0.153^{d}	570.53 ± 0.058^{a}	401.16 ± 0.076^{c}
Zn**(mg/100g)**	3.76 ± 0.003^{a}	1.36 ± 0.031^{c}	1.86 ± 0.010^{b}	1.14 ± 0.020^{d}
Mg**(mg/100g)**	12.72 ± 0.026^{c}	10.70 ± 0.107^{d}	14.27 ± 0.027^{b}	25.22 ± 0.233^{a}
P**(mg/100g)**	72.60 ± 0.048^{d}	131.91 ± 0.260^{c}	150.73 ± 0.011^{b}	153.15 ± 0.050^{a}
Fe**(mg/100g)**	3.33 ± 0.071^{a}	2.28 ± 0.068^{b}	1.40 ± 0.009^{d}	1.70 ± 0.009^{c}
Cu**(mg/100g)**	0.17 ± 0.002^{c}	0.03 ± 0.003^{b}	0.10 ± 0.004^{c}	0.53 ± 0.061^{a}
Se**(mg/100g)**	0.02 ± 0.003^{b}	0.03 ± 0.002^{b}	0.01 ± 0.01^{b}	10.11 ± 0.076^{a}
I**(mg/100g)**	2.85 ± 0.006^{d}	4.26 ± 0.007^{b}	3.72 ± 0.019^{c}	4.40 ± 0.051^{a}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same row are statistically not significant at (P<0.05).

The phytochemicals content of the sample is shown on table 3. Polyphenol (27.18%), flavonoids (7.12%), phytate (1.23%) and saponin (0.35%) was significantly ($p<0.05$) higher in curry leaf while turmeric had the highest alkaloids (60.32%) content and was significantly differ ($P<0.05$) in value from other spices. Ginger had the least value for phytate (0.58%) followed by turmeric (0.74%). Garlic was significantly ($p<0.05$) lower in alkaloid (22.43%) than the other spices.

Table 3: Phytochemicals composition of the spices (Turmeric, Ginger, Curry and Garlic) per 100g dry weight

Phytochemicals	Turmeric powder	Ginger powder	Curry powder	Garlic powder

Alkaloid	60.32±.049[a]	51.53±5.78[b]	28.28±.026[c]	22.43±.068[d]
Polyphenol	25.05±.050 [b]	20.36±.115 [c]	27.18±15.19 [a]	18.64±0045[d]
Saponin	0.28 ±.004[c]	0.21±.004[d]	0.35±.009 [a]	0.325±.001[b]
Flavonoids	6.15± 0.03 [c]	4.88±.024[d]	7.12±.006 [a]	6.38±.029 [b]
Phytate	0.74±.051 [c]	0.58±.013[d]	1.23±.057[a]	0.84±.015[b]

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same row are statistically not significant at (P<0.05).

DISCUSSION

Spices studied in this research confer some nutritional benefits, antioxidants effects in addition to improving the organoleptic characteristics of food such as taste, colours and aroma to food and soups. It also contains an appreciable amount of phytochemicals. Findings revealed that the spices had a low moisture and fat content, these features may decreases microbial activity and prevent rancidity respectively and this invariable prolong the shelf life of the spices than when they are in fresh form (17,18). The ash content of the samples in this study ranges between (4.16%-5.26%), this value disagreed with the 9% recorded by Abil and Elegalam (19) in *T. tetraptera* but similar to the 3.4% reported by Udourioh and Etokudoh (20). Ash content gives an indication of high inorganic mineral content of the spices (21). The carbohydrate content ranged between 62.53% and 73.35%. The values of carbohydrate presence in each of the spices were higher than the mean value of carbohydrate (18.41%), reported in bouillon cubes by (22). Appreciable amount of Protein was found in the spices. Ginger and turmeric had the highest content and can contribute significantly to the protein intake of the consumers and reduce protein malnutrition particularly among the low income earners and the rural populace. The protein content of turmeric in this study was higher than the value in *Monodora myristica* (9.6g/100g) but lower than the protein value reported by Stephen and colleagues (23) while the protein content of ginger was higher than the figure obtained in *Ocimum gratissimum* (4g/100g) by Adegbola et al. (24). Protein content of spices may be useful in the formation of new body structure, nutrients movement and maintenance of body fluid (25). The quantity of protein, lipid and crude fibre reported in this study was lower than the figure reported in T*etrapleura tetraptera* Schumach ("aridan") which had an appreciable amount of crude fiber 17%–20.24%, crude lipid (4.98%–20.24%), and crude protein (7.44%–17.5%) (20).

Spices are good sources of nutrients, mineral elements this was confirmed by the result presented in (table 2). All the spices have an appreciable amount of mineral elements. Mineral elements are needed in human in smaller quantity for the maintenance of good health while excessive intake might be toxic. The high amount of minerals in the spices seen in (table 2) was likened with the high ash content in the entire spices sample as shown in (table 1). In this study, potassium, phosphorus and calcium was particularly high in all the spices samples content which made the spices to be minerals packed in the mix of spices used in cooking soup in south west. Potassium, phosphorus and calcium are essential macro elements which are of prime significant in influences osmotic pressure and contribute to normal pH equilibrium, development of skeletal tissues, formation of nucleic acids and energy storage (26), and in the formation of body and a major constituent of body fluids respectively (26). The daily requirement of potassium, phosphorus and calcium are 4700mg/day, 700 mg/day and 1000mg/day for adult men and women respectively (27). An average of 8% of potassium required per day can be provided by these spices except for ginger while about 19% of the phosphorus can be provided except for turmeric. On the other hand 18% of calcium required per day can be fulfilled by consuming 100gram of turmeric and garlic. Considering the level of sodium present in spices, the spices could be said to be low in sodium which makes them a good ingredients for hypertensive patients. The values of zinc and iron present in the turmeric could successfully supplied 21% and 24% of RDA of an adult this makes turmeric a good sources of zinc and iron to our diet.

Abil and Elegalam (23), noted that the fruits of *T. tetraptera* contained 10.59 mg 100g and 12.02 mg 100g of iron and zinc respectively. These values were higher than the value for the turmeric, ginger, curry and garlic reported in this study. Zinc and iron plays a vital role in growth and protein synthesis, collagen formation and a major component of haemoglobin and myoglobin that are involved in the transport and metabolism of oxygen (25). Although, these two metals are essential, very high concentrations of them could be more deleterious than nutritious.

In this study, garlic had the highest concentration of copper (0.53mg), selenium (10.11mg) and iodine (4.40mg) as shown in (table 2).

The recommended dietary allowance for selenium and iodine for an adult are 55mcg and 150mcg respectively (28). More than this value can easily be provided by consuming 100gram of garlic to soups. While about 60% of the copper required for normal functioning of the body per day be met by 100gram of garlic. The role of these three micro minerals cannot be

underestimated, apart from the fact that Cu plays an important role in the body which includes utilization of iron stores, production of melanin it also helps in neurotransmitter synthesis (26). In the same vain, selenium protects cells against destruction by hydrogen peroxide and free radicals while iodine helps in thyroid hormone synthesis (26).

This study has revealed that all the spices contained appreciable amount of phytochemicals, most especially alkaloids, flavonoids and Polyphenol. Phytochemicals are chemical constituent which are neither vitamins nor minerals found in plants needed in smaller quantity for their health benefits (29). In this study, all the spices demonstrated abundant present of alkaloid, flavonoids, polyphenol compared to the value of alkaloid (0.86%), flavonoids (0.72%), and polyphenols (0.66%) reported in the seeds of *P. guineense* by Chiwendu et al., (30). The present of alkaloids in the methanolic extracts of the spices shows that they possessed medicinal properties. Alkaloids are made up of heterocyclic nitrogen that has been shown to exhibit antimalarial, antihypertensive, antiarrhythmic, and anticancer properties (31,32), treatment of cough, asthma and hay fever due to the possession of important biological activities (33,34,35).

Flavonoids have been reported to possess antioxidant, anti-inflammatory, antitumor, antiallergic, and antiplatelet activity (36, 37). In the same vain, saponins have been reported to have antimalarial effect (38). The quantity of saponins detected in these spices supports its antimalarial activity; although the quantities were lower than the reported (1.88%) in 'iyeree' (*Piper guineense* Schum) by Chiwendu et al. (30). Saponins are second metabolites which are widely found in the plant kingdom. It acts as a chemical barrier or shield in the plant defense system to counter pathogens and herbivores (39). The presence of Saponin in the spices shows that the spices could have cytotoxic effect such as permealization of the intestine (40). The amount of Phytate in all the spices was below the safe level of 5.00mg/ 100g (41). Excess consumption of Phytate not only interferes with micronutrients absorption but also impair protein digestibility (42) Study had shown that consumption above the safety level are detrimental to human health (41) but the value provided in (table 3) for all the spices were considerably lower than and safe for human consumption.

CONCLUSION

This study has provided very vital information on the nutrients and phytochemical composition of spices used in the preparation of soups in south west of Nigeria. The four spices had appreciable amount of protein, carbohydrate and crude fibre. The spices were also abundant in potassium, phosphorus, copper, selenium, iron and zinc. Alkaloids and flavonoid were the two most present phytochemicals in the spices. Phytate content of the spices were within the safe level for human consumption. The result suggest that the spices if use properly in the preparation of soups and meal in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases.

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