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(RESEARCH ARTICLE)

Assessment of minerals and vitamin constituents of some commonly consumed spices

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Abstract

The minerals and vitamin components of five commonly consumed spices such as Ginger, Garlic, Turmeric, Black pepper and Cloves were evaluated using standard methods. Mineral composition results showed that the calcium content (mg/100g) in Ginger, Garlic, Turmeric, Black pepper and Cloves were 338.17, 282.18, 346.51, 438.61 and 274.63, respectively. The levels of potassium in all the spices ranged from the least 68.47 in garlic to the highest 96.05 in black pepper and Sodium concentrations in all the spices were 23.41 in ginger, 20.15 in garlic, 21.78 in turmeric, 38.82 in black pepper and 26.64 in cloves. Other micro nutrients such as iron copper, zinc, selenium and manganese were found in traces in all the spices while the toxic metals such as lead and cadmium were not detected in all the spices. The results of vitamin contents of all the five spices showed that Thiamine, Vitamin B1 contents (mg/100g) of Ginger, Garlic, Turmeric, Black pepper and Cloves were 32.13, 24.29, 38.61, 28.84 and 27.46, respectively, vitamin B2, Riboflavin contents of the spices ranged from 25.63 in Garlic to 48.24 in Ginger, Niacin, vitamin B3 concentrations varied significantly among the spices and ranged between 15.82 in Ginger to 23.22 in Cloves, Vitamin B6 [Pyridoxine] concentration in the spices ranged from the least 27.18 in Garlic to the highest 31.81 in Black pepper, The Folic acid [Vitamin B9] ranged from 11.23 in Garlic to 16.46 in Turmeric, Vitamin B12 concentration of the spices ranged from19.64 in Ginger to 15.13 in Black pepper. Vitamin C in the Cloves had the highest 143.54 value and the least 38.24 was obtained in Ginger. Vitamin A content of the spices ranged from 56.11 in Ginger to 151.74 in Turmeric while Vitamin E contents of the spices were 10.23 the least in Ginger and 22.51 the highest in Cloves. The study revealed that the spices contained appreciable amount of nutritionally valuable minerals that body required for normal physiological functions, the spices also contained adequate amount of both fat and water soluble vitamins required by the body which can serve as body defence. Immune builder and good antioxidants.

Keywords: Minerals; Vitamins; Spices; Constituents; Consumed

1. Introduction

In the context of nutrition, a mineral is a chemical element required as an essential nutrient by organisms to perform functions necessary for life [1, 2], however, the four major structural elements in the human body by weight (oxygen, hydrogen, carbon, and nitrogen), are usually not included in lists of major nutrient minerals (nitrogen is considered a "mineral" for plants, as it often is included in fertilizers). These four elements compose about 96% of the weight of the human body, and major minerals (macrominerals) and minor minerals (also called trace elements) compose the remainder.Nutrient minerals, being elements, cannot be synthesized biochemically by living organisms.Plants get minerals from soil. Most of the minerals in a human diet come from eating plants and animals or from drinking water

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[3]. As a group, minerals are one of the four groups of essential nutrients, the others of which are vitamins, essential fatty acids, and essential amino acids [4]. The five major minerals in the human body are calcium, phosphorus, potassium, sodium, and magnesium [5]. All of the remaining elements in the human body are called "trace elements". The trace elements that have a specific biochemical function in the human body are iron, chlorine, cobalt, copper, zinc, manganese, molybdenum, iodine, and selenium [5]

Nutritionally, minerals are generally subdivided into two groups, macrominerals and trace minerals (microminerals). The macrominerals include calcium, magnesium, potassium, phosphorus and sodium. These are the minerals that are required in large amounts in the body. Trace or microminerals, on the other hand, are those minerals that are required only in minute quantities in the body. These include zinc, copper, chromium, selenium, molybdenum, manganese, iodine, iron, boron, silicon, and vanadium. Though only required in small quantities, they are, nevertheless, essential for good health [6. 1] Unlike vitamins, minerals are very stable in composition and do not get degraded by heat, cooking or light. They maintain their nutritional value through the cooking process, even if baked or boiled. It is, therefore, possible to incorporate minerals in numerous recipes to help prevent a nutritional deficiency. This is especially important for individuals on special diets who may not get their mineral requirements from the foods they eat. Individuals on a dairy free diet, for instance, don't get enough calcium for good health. These individuals can incorporate calcium into various prepared foods such as bread, casseroles, cookies, juices and semi-solid foods.

A vitamin is an organic molecule (or a set of molecules closely related chemically, i.e. vitamers) that is an essential micronutrient which an organism needs in small quantities for the proper functioning of its metabolism. Essential nutrients cannot be synthesized in the organism, either at all or not in sufficient quantities, and therefore must be obtained through the diet[7] Most vitamins are not single molecules, but groups of related molecules called vitamers. For example, there are eight vitamers of vitamin E: four tocopherols and four tocotrienols. Some sources list fourteen vitamins, by including choline[8] but major health organizations list thirteen: vitamin A (as all-trans-retinol, all-trans-retinyl-esters, as well as all-trans-beta-carotene and other provitamin A carotenoids), vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B5 (pantothenic acid), vitamin B6 (pyridoxine), vitamin B7 (biotin), vitamin B9 (folic acid or folate), vitamin B12 (cobalamins), vitamin C (ascorbic acid), vitamin D (calciferols), vitamin E (tocopherols and tocotrienols), and vitamin K (phylloquinone and menaquinones) [9].

Vitamins are classified as either water-soluble or fat-soluble. In humans there are 13 vitamins: 4 fat-soluble (A, D, E, and K) and 9 water-soluble (8 B vitamins and vitamin C). Water-soluble vitamins dissolve easily in water and, in general, are readily excreted from the body, to the degree that urinary output is a strong predictor of vitamin consumption [10]. Because they are not as readily stored, more consistent intake is important. Fat-soluble vitamins are absorbed through the intestinal tract with the help of lipids (fats). Vitamins A and D can accumulate in the body, which can result in dangerous hypervitaminosis. Fat-soluble vitamin deficiency due to malabsorption is of particular significance in cystic fibrosis [11]. **Vitamins are** several organic substances that are necessary in small quantities for normal health and growth in higher forms of animal life. Vitamins are distinct in several ways from other biologically important compounds such as proteins, carbohydrates, and lipids. Although these latter substances also are indispensable for proper bodily functions, almost all of them can be synthesized by animals in adequate quantities. Vitamins, on the other hand, generally cannot be synthesized in amounts sufficient to meet bodily needs and therefore must be obtained from the diet or from some synthetic source. For this reason, vitamins are called essential nutrients. Vitamins also differ from the other biological compounds in that relatively small quantities are needed to complete their functions. In general these functions are of a catalytic or regulatory nature, facilitating or controlling vital chemical reactions in the body's cells. If a vitamin is absent from the diet or is not properly absorbed by the body, a specific deficiency disease may develop. This study is therefore designed to evaluate the mineral and vitamin constituents of some commonly consumed nutraceutical spices to affirm their application as food supplements and health management.

2. Material and methods

2.1. Samples collections and preparation

Matured Ginger root *(Zingiber officinale R.)* and Garlic bulb *(Allium sativum L.)* were purchased directly from a farm in Mubi Nigeria, while Turmeric (*Curcuma longav L.*), Cloves (*Syzygium aromaticum L.*) and Black pepper (*Piper nigrum L.*) were also purchased directly from a farm in Oda and Aba-Oyo villages in Akure, Nigeria. The samples were authenticated at the Department of Crop, Soil and Pest Management of The Federal University of Technology, Akure, Nigeria.The samples were thoroughly washed, chopped, drained and ground with an electric grinder. Thereafter, the powdered samples were air-dried at ambient temperature, transferred into screw-caped air tight plastic rubber and refrigrated at 4°C prior analysis.

2.2. Mineral analysis

The nutritionally important minerals in the *spices* sample were determined from solution obtained as follows: Samples (l.5 g) was pre- ashed by putting the sample in a dish and heated gently on a Bunsen burner in a fume cupboard until the charred mass had ceased to emit smoke. It was transferred to muffle furnace at 550 °C. Heating was continued until all the carbon was burnt away. The crucible plus ash was transferred to a dessicator to cool after which (20 ml) of 0.1M HCl solution was added to the content in the crucible to break up ash, it was then filtered through acid washed Whatman filter paper into 100 ml volumetric flask and made up to the mark with distilled water. Atomic absorption spectrophotometer was used for the analysis of the following metals: Ca, Fe, Mg, Zn, Mn, Cu, Pb, Cd. Na and K were determined with flame photometer. The standard for each metal using suitable salt of each metal was prepared. All the metals analyzed for, used hollow cathode lamps and air acetylene flame. The standard for each metal was aspirated into the flame as well as the samples and their respective concentrations in mg/100 g were read for each sample, while the absorbance of the standard was noted [12].

2.3. Determination of vitamins

2.3.1. Determination of Vitamin A (Retinol)

A quantity, one gram, of the sample was weighed and macerated with 20 ml of n- hexane in a test tube for 10 minutes. Then 3 ml of the upper hexane extract was transferred into a dry test tube in duplicates and evaporated to dryness. Following this, 0.2 ml of acetic anhydride chloroform reagent was added and 2 ml of 50% trichloroacetic acid (TCA) in chloroform was also added. The absorbance was taken at 15 seconds and 30 seconds intervals at 620 nm.

2.3.2. Determination of Vitamin C (Ascorbic acid)

About 0.5g of the sample was weighed, macerated with 10mls of 0.4% oxalic acid in a test tube for 10 minutes, centrifuged for 5 minutes and the solution filtered. 1 ml of the filtrate was transferred into a dry test tube in duplicates, 9mls of 2,6- dichlorophenol indophenol was added and absorbance was taken at 15 seconds and 30 seconds interval at 520 nm.

2.3.3. Determination of Vitamin E (Tocopherol)

One gram (1g) of the original sample was weighed, macerated with 20 ml of n- hexane in a test tube for 10 minutes and centrifuged for 10 minutes. The solution was filtered, 3 ml of the filtrate was transferred into a dry test tube in duplicates and evaporated to dryness in a boiling water bath. Following this, 2 ml of 0.5N alcoholic potassium hydroxide was added and boiled for 30 minutes in a water bath. Then 3mls of n-hexane was added and was shaken vigorously. The n-hexane was transferred into another set of test tubes and evaporated to dryness. A volume, 2 ml, of ethanol was added to the residue. Another volume, 1 ml of 0.2% ferric chloride in ethanol was added. Then 1 ml of 0.5% 1 1 -dipyridyl in ethanol was added followed by the addition of 1ml of ethanol to make it up to 5mls. The solution was mixed and absorbance taken at 520 nm against the blank.

2.3.4. Determination of Vitamin B1 (Thiamin)

About 5 g of the sample was homogenized with 50 ml ethanolic sodium hydroxide. It was filtered into a 100 ml conical flask 10 ml of the filtrate was pipette and the colour was develop by addition of 10ml of potassium dichromate and read at 360 nm. A blank solution was also prepared.

2.3.5. Determination of Vitamin B2 (Riboflavin)

About 5 g of the sample was extracted with 100 ml of 50% ethanol and shaken for 1hour. This was filtered into 100ml flask 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10ml of 30% H_2O_2 was added and allowed to stand over a hot water bath for 30 min. 2 ml of 40% sodium sulphate was added. This was then made to the mark with water and the absorbance was read at 510 nm.

2.3.6. Determination of Vitamin B3 (Niacin)

About 5 g of the sample was treated with 50ml of 1N H_2SO_4 and shaken for 30 min. 3 drops of ammonia solution were added to the sample and filtered. 10 ml of the filtrate was pipette into a 50 ml volumetric flask and 5ml of potassium cyanide was added. This was acidified with 5ml of 0.02N H_2SO_4 and absorbance was measure using spectrophotometer at 470 nm wavelength [12].

2.4. Statistical Analysis

The data obtained were subjected to one-way analysis of variance (ANOVA), and differences between samples at P ≤0.05 were separated by Duncan multiple range test using the Statistical Package for Social Sciences (SPSS 23) program. Experimental results were expressed (where appropriate) as mean ± SDV (standard deviation).

3. Results and discussion

Table 1 Mineral Composition (mg/100g) of the Spices

Metals	Ginger	Garlic	Turmeric	Black pepper	Cloves
Calcium (Ca)	338.17^{c}± 5.01	282.18^{b}± 3.06	346.51^{d}± 3.08	438.61^{e}± 6.05	274.63^{a}± 4.02
Magnesium (Mg)	134.46^{b}± 1.`7	117.26^{a} ± 1.06	156.08^{c}± 3.03	192.63^{e}± 9.04	178.04^{d}± 4.02
Sodium (Na)	23.41^{c}± 0.03	20.15^{a}± 0.02	21.78^{b}± 0.04	38.82^{e}± 0.02	26.64^{d}± 0.02
Potasium (K)	85.18^{d} ± 0.02	68.47^{a}± 0.03	79.34^{b}± 0.02	96.05^{e} ± 0.41	80.48^{c} ± 0.11
Selenium (Se)	2.63^{c}± 0.03	1.09^{a} ± 0.02	2.58^{b}± 0.03	3.36^{e}± 0.02	2.62^{d} ± 0.03
Manganese (Mn)	1.34^{b}± 0.01	0.92^{a}± 0.00	2.08^{c}± 0.02	3.41^{d}± 0.02	3.88^{e}± 0.02
Lead(Pb)	BDL	BDL	BDL	BDL	BDL
Cadmium (Cd)	BDL	BDL	BDL	BDL	BDL
Zinc (Zn)	6.08^{a} ± 0.02	7.41^{b} ± 0.01	8.62^{c} ± 0.03	12.64^{e} ± 0.01	10.06^{d} ± 0.03
Copper (Cu)	0.67^{b} ± 0.03	0.54^{a} ± 0.03	0.83^{d} ± 0.03	0.82^{d} ± 0.01	0.74^{c} ± 0.01
Iron (Fe)	2.41^{b}± 0.01	1.74^{a} ± 0.04	3.62^{c} ± 0.02	5.75^{d} ± 0.03	5.71^{d} ± 0.02
Na/K	0.27	0.29	0.27	0.41	0.33

Values are mean ± standard deviation of triplicate determinations;Mean follows different superscript are significant at p ≤ 0.05

3.1. Mineral Composition of the spices

Table 1 showed the mineral composition of the spices. Minerals are needed for the proper composition of body fluids, including blood, and for the proper composition of tissues, bone, teeth, muscles and nerves. Minerals also play a significant role in maintaining healthy nerve function, the regulation of muscle tone, and supporting a healthy cardiovascular system [13]. In the context of nutrition, a mineral is a chemical element required as an essential nutrient by organisms to perform functions necessary for life [1]. The results showed that Calcium and Magnesium are the most abundant minerals and their concentrations varied significantly in all the five spices. The Calcium content (mg/100g)in Ginger, Garlic, Turmeric, Black pepper and Cloves were 338.17, 282.18, 346.51, 438.61 and 274.63 which showed that the highest concentration was found in black pepper while the lowest was obtained in the cloves. These are within the range of 289.69 and 270.72 (mg/100g) reported for onion and garlic[14], lower than 633.9 mg100g and 510.7 reported by [15] for *Croton penduliflorus*, but far higher than the nutmeg (37.5 mg/100g) reported [16]. They are also noted to be higher than the calcium in ginger (25.76 mg/100g) reported [17].

The major function of calcium is to build and maintain healthy bones and teeth; however, it is also involved in much of the body's enzyme activity as well as regulation of cardiovascular function [18[. Calcium deficiency can lead to rickets (a bone deformity disease) and growth retardation in children. In adults, deficiency can lead to osteoporosis, poor bone density, muscle spasms, leg cramps and cardiovascular irregularities. Magnesium was also high in all the five spices with the least 117.26 value obtained in garlic and the highest 192.68 was found in black pepper. Magnesium is the most important major mineral that is needed in the body, it is use to correct assimilation of potassium and the efficient functioning of the enzymes which are involve in transport, storage and utilization of energy, magnesium also helps in the regulation of cell metabolism such as DNA and RNA synthesis, they are also needed for bone strength. Magnesium is an activator of many enzymes in the body system and maintains the electrical potential of nerves [19].

The levels of potassium in all the spices ranged from the least 68.47 in garlic to the highest 96.05 in black pepper. These are within the range of *Allium cepa* (90.25 mg/100g) and *Allium sativum* (83.70 mg/100g) reported by [14], (229.00 mg/100g) wasalso reported for Ashanti pepper [17] which was higher than the values reported in this study. Potassium is one of the main blood mineral called electrolyte, it is important to both cellular and electrical function, high potassium

concentration helps to prevent hypertension, and with sodium, it regulate the body [20]. Sodium concentrations in all the spices were 23.41 ginger, 20.15 garlic, 21.78 turmeric, 38.82 black pepper and 26.64 in cloves. These are closed to the values reported for both *Allium cepa* (40.67 mg/100g) and *Allium sativum* (38.67 mg/100g) by [14], sodium is important for keeping a balance in pressure between the inside and outside of the cell, high sodium levels intake can lead to high blood pressure which can increase the risk of heart attack or stroke [21]. This shows that all the five spices are good for consumption as it contains low level of sodium for proper osmotic regulation. Selenium is an essential tract element in humans and animals. It is involved in a healthy immune system, the detoxification process and also has high antioxidant activity. It works synergistically with vitamin E and vitamin C in preventing the formation of free radicals. However, Selenium was found in various concentrations in all the five spices ranged from the least 1.09 in garlic and the highest 3.36 in black pepper which indicates that the spices had adequate amount of selenium that could enhance immune system and proper body detoxification.

Copper concentrations were found in trace in all the five spices and ranged from 0.54 the least in garlic to 0.83 the highest in turmeric. Copper is an essential trace mineral in human and animal nutrition. Copper aids in the formation of various human tissues and red blood cells. It also works synergistically with zinc and vitamin C in the formation of skin protein. Though rare in humans, copper deficiency can prevent normal growth and development.

Most individuals consume enough copper in their diets so that additional supplementation is not necessary. In fact, excessive copper intake can lead to copper toxicity and a drop in zinc and vitamin C levels. Zinc is a mineral that is essential to humans and animals, and it plays several vital roles in maintaining good health. Zinc is involved in more than 200 enzymatic reactions that make up our metabolic processes. Other vital functions of zinc include: maintaining growth and development, maintaining a healthy, effective immune response, supporting healthy skin and proper wound healing and supporting sexual maturation and reproduction. Concentration of zinc varied significantly in all the five spices as the least 6.08 was found in ginger, 7.41 in garlic, 8.62 in turmeric and 10.06 in cloves while the highest 12.64 was obtained in black pepper. Zinc present in pancreas may aid the storage of insulin while in plants could serve in the management of diabetes which results from insulin malfunction [22] .

The levels of Manganese in all the spices also ranged from 0.92 in garlic to 3.88 in the cloves, which showed that the spices contained adequate amount of Manganese required for normal body physiology. Manganese help to create essential enzymes for building bones, it helps in formation of connective tissue, absorption of calcium, regulation of sugar level and also important for brain and nerve functioning. Lack of manganese causes testicular atrophy and higher level of this mineral element in plants and animal has toxic effect [19]. Iron is required for the formation of blood cells and its deficiency causes anaemia [21]. The levels of iron concentrations in all the spices were between the range of 1.47 in garlic to 5.75 in black pepper which are within the range of iron contents of 2.65 mg/100g obtained in the onion and 2.49 mg/100g in garlic as reported by [14]. Low Iron concentration in the blood can leads to tiredness and fatigue [21].

Table 2 Vitamin contents (mg/100g) of Whole Spices

Vitamins	**Ginger**	**Garlic**	**Turmeric**	**Black pepper**	**Cloves**
Thiamine (B1)	$32.13^{d} \pm 0.37$	$24.21^{a} \pm 0.02$	$38.61^{e} \pm 0.04$	$28.84^{b} \pm 0.05$	$27.46^{c} \pm 0.04$
Riboflavin(B2)	$48.24^{e} \pm 0.03$	$25.63^{a} \pm 0.03$	$40.36^{d} \pm 0.03$	$28.91^{b} \pm 0.03$	$29.15^{c} \pm 0.06$
Niacin (B3)	$15.81^{a} \pm 0.21$	$18.62^{b} \pm 0.01$	$19.21^{c} \pm 0.04$	$20.93^{d} \pm 0.04$	$23.26^{e} \pm 0.03$
Pyridoxine (B6)	$24.92^{b} \pm 0.06$	$27.18^{c} \pm 0.04$	$22.61^{a} \pm 0.02$	$31.81^{e} \pm 0.02$	$29.43^{d} \pm 0.03$
Folic acid (B9)	$13.22^{b} \pm 0.03$	$11.23^{a} \pm 0.03$	$16.46^{e} \pm 0.03$	$14.22^{c} \pm 0.02$	$15.81^{d} \pm 0.03$
Cobalamine (B12)	$10.64^{a} \pm 0.07$	$13.14^{c} \pm 0.03$	$12.84^{b} \pm 0.03$	$15.13^{e} \pm 0.03$	$14.72^{d} \pm 0.02$
Ascorbic acid (C)	$38.24^{a} \pm 0.03$	$74.47^{c} \pm 0.04$	$60.18^{b} \pm 0.03$	$138.36^{d} \pm 0.13$	$143.54^{e} \pm 0.04$
β-Carotene (A)	$56.11^{a} \pm 0.03$	$68.17^{b} \pm 0.04$	$151.74^{e} \pm 0.12$	$92.14^{d} \pm 0.02$	$83.43^{c} \pm 0.03$
α-Tocopherol(E)	$10.23^{a} \pm 0.07$	$13.13^{c} \pm 0.04$	$11.24^{b} \pm 0.03$	$15.32^{d} \pm 0.04$	$22.51^{e} \pm 0.03$

Values are mean ± standard deviation of triplicate determinations ; Mean follows different superscript are significant at $p \leq 0.05$

Generally, Sodium, potassium, calcium and magnesium play a central role in the normal regulation of blood pressure. These elements in particular were reported to have important interrelationships in the control of arterial resistance [22]. Literature also reported that Zinc and chromium are well known trace elements in diabetes as cofactors for insulin

while calcium, magnesium and phosphorus are also essential for bone and teeth formation [23]. The importance of these elements cannot be overemphasized because they are required by many enzymes as co-factors [24]. The sodium potassium ratio of all the spices were far below 1.0 as recommended. And finally, the non-detection of Lead and Cadmium is of great advantage to consumers of these spices as these elements have been reported to be highly toxic even at low concentrations [20]. The presence of the minerals varied significantly among the spices which implies that the spices were very rich in nutritionally valuable minerals that required for normal body physiological function if consumed either as a whole or as food supplement.

3.2. Vitamins Components of the Spices

Vitamin is an organic molecule (or a set of molecules closely related chemically, i.e. vitamers) that is an essential micronutrient which an organism needs in small quantities for the proper functioning of its metabolism. Essential nutrients cannot be synthesized in the organism, either at all or not in sufficient quantities, and therefore must be obtained through the diet [7]. The vitamin contents of all the five spices were presented in Table 2. Thiamine, Vitamin B1 contents (mg/100g) of ginger, garlic, turmeric, black pepper and cloves were 32.13, 24.29, 38.61, 28.84 and 27.46, respectively. The main function of Vitamin B1 is to serve as component of a coenzyme in carbohydrate metabolism; supports normal nerve function and its deficient could lead to impairment of the nerves and heart muscle wasting. The vitamin B2, Riboflavin contents of the spices ranged from 25.63 in garlic to 48.24 in ginger, its main function is as a component of coenzymes required for energy production and lipid, vitamin, mineral, and drug metabolism as well as antioxidant while its deficiency may result to inflammation of the skin, tongue, and lips; ocular disturbances; nervous symptoms [25[.

Niacin concentrations varied significantly among the spices and ranged between 15.82 in ginger to 23.22 in cloves. Vitamin B3 plays a vital role as a component of coenzymes used broadly in cellular metabolism, oxidation of fuel molecules, and fatty acid and steroid synthesis. Vitamin B6 [Pyridoxine] also serve as a component of coenzymes in metabolism of amino acids and other nitrogen-containing compounds; synthesis of hemoglobin, neurotransmitters and generally regulation of blood glucose levels, its concentration in the spices ranged from the least 27.18 in garlic to the highest 31.81 in black pepper. The Folic acid [Vitamin B9] was ranged from 11.23 in garlic to 16.46 in turmeric, Vitamin B9 also known as folate or folacin function as a component of coenzymes in DNA synthesis, metabolism of amino acids; required for cell division, maturation of red blood cells component of coenzymes in DNA synthesis, metabolism of amino acids; required for cell division, maturation of red blood cells while its deficiencycould result to impaired formation of red blood cells, weakness, irritability, headache, palpitations, inflammation of mouth, neural tube defects in foetus.

Cyanocobalamin is also known as Vitamin B12 with a role as a cofactor for enzymes in metabolism of amino acids (including folic acid) and fatty acids; required for new cell synthesis, normal blood formation, and neurological function. Deficiency of vitamin B12 could result to smoothness of the tongue, gastrointestinal disturbances and nervous symptoms. Vitamin B12 concentration of the spices ranged from19.64 in ginger to 15.13 in black pepper. The results obtained in this study for the B vitamins in all the spices were higher than 0.24 and 1.60 reported for Garcinia kola and *Aframomum. Meleguata*]26], trace amount 0.13-0.46 of B vitamins were also reported [25] for Ficuscapensis leaves. Vitamin C Ascorbic acid is another water soluble vitamin that was obtained at various concentrations in the spices. Vitamin C plays a major role in the body as antioxidant; synthesis of collagen, carnitine, amino acids, and hormones; immune function; enhances absorption of non-haem iron (from plant foods). Vitamin C was very high in all the spices especially in the cloves having the highest 143.54 value followed by 138.36 in black pepper, 74.47 in garlic, 60.18 in turmeric and least 38.24 was obtained in ginger. These values are higher than 23.1 and 12.3 reported for G. kola and A. meleguata [26], also higher than 2.32, 4.97 and 1.59 reported for *Piper guineense, Xylopia aethiopica* and *Ocimum gratissimum* [27]and (3.18mg/100ml) for *Solanum nigrum* [28]. Vitamin C deficiency could lead to swollen and bleeding gums, soreness and stiffness of the joints and lower extremities, bleeding under the skin and in deep tissues, slow wound healing including anemia, scurvy [29, 30].

Vitamin A also known as retinol, retinal, retinoic acid, beta-carotene (plant version) is a fat soluble vitamin with biological function for normal vision, integrity of epithelial cells (mucous membranes and skin), reproduction, embryonic development, growth, immune response [30]. Vitamin A content of the spices ranged from 56.11 in ginger to 151.74 in turmeric. These are higher than the values ranged from 25.22mg/100ml in Ficus capensis to 108.48mg/100ml in *Moringa oleifera* was reported [28], likewise, [27] reported vitamin A contents of 64.82, 54.99 and 74.54(mg/100g)f or *Piper guineense, Xylopia aethiopica* and *Ocimum gratissimum,* respectively. Vitamin A deficiency could cause ocular disturbances leading to blindness, growth retardation, dry skin, diarrhea, vulnerability to infection.

Vitamin E also known as alpha-tocopherol, tocopherol or tocotrienol has a biological function as a powerful antioxidant; interruption of free radical chain reactions; protection of polyunsaturated fatty acids, cell membranes helps to protect

cells from damage by free radicals and it is vital to the formation and normal function of red blood cell and muscles [31]. Vitamin E contents of the spices were 10.23 the least in ginger, 13.13 in garlic, 11.24 in turmeric, 15.32 in black pepper and 22.51 the highest in cloves. These are higher than Vitamin E content varied from 3.39 to 7.71mg/100ml was reported by [28] for leafy vegetables. [27] also reported Vitamin E content varied from 2.12 mg/kg to 5.18 mg/kg in *Ricinusb communis* and *Xylopia aethiopica* respectively. Vitamin E deficient may cause peripheral neuropathy and damage or breakdown of red blood cells [31]. However, the results obtained in this study revealed that all the spices contained adequate amount of vitamins required by the body which can serve as body defence. Immune builder, good antioxidants and this implies that the spices are good raw material for the production of some medicinal drugs, food supplement and can be used in folk medicine for the treatment and prevention of some diseases.

4. Conclusion

The minerals and vitamins constituents of five commonly consumed spices have been scientifically evaluated in this study. The results of mineral composition of all spices followed almost the same trend with slight different in concentrations of all the minerals which implies that the spices were very rich in nutritionally valuable minerals that are required for normal body physiological function if consumed either as a whole or as a supplement. Vitamin components of the spices showed the presence of water soluble vitamins that is Bs and C as well as the fat soluble ones such as A and E were also abundantly present in all the spices. However, the results obtained in this study revealed that all the spices contained adequate amount of vitamins required by the body which can serve as body defence, Immune builder, good antioxidants and this implies that the spices are good raw material for the production of some medicinal drugs, food supplement and can be used in folk medicine for the treatment and prevention of some diseases.

Compliance with ethical standards

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No conflict of interest to be disclosed.

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