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Proximate And Phytochemical Analysis Of Some Selected Spices; Garlic (Allium Sativum), Ginger (Zingiber Officinale) And Onion (Allium Cepa)

Abdulkadir Shehu[1*], Abubakar Shehu[1] and Bara'u Yahaya[2]

[1]*Department of Biological Sciences, Faculty of Science, Sokoto State University, Nigeria*

[2]*Department of Biological Sciences, Faculty of Chemical and Life Sciences, Usman Danfodiyo University, Sokoto Nigeria*

[*]Corresponding Author
Abdulkadir Shehu, Department of Biological Sciences, Faculty of Science, Sokoto State University, Nigeria.

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Abstract

Spices not only just stimulate the taste buds but are composed of notable list of phyto-nutrients, essential oils, antioxidants, minerals and vitamins that are necessary for good health. Also confirms that most seasonings are sources of nutrients [1]. Proximate and Phytochemical analysis of three spices, Garlic (Allium sativum), Ginger (Zingiber officinale) and Onion (Allium cepa) was conducted. The result of proximate analysis shows that, in the three spices investigated, Carbohydrate had the highest content of 51.50% and 49.09% in Onion and Garlic, followed by Lipid 46.48% in Garlic and the least was Ash. In the three spices investigated, eleven phytochemicals was identified out of which Saponins, Flavonoids, Cardiac Glycosides, Glycosides and Alkaloids are in moderate amount while Flavonoids, Glycosides, Cardiac Glycosides are in trace amount. Anthraquines and Volatile Oils. The study showed that the spices selected; Garlic, Ginger and Onion possess considerable amount of constituents and phytochemicals. Garlic possessed more crude lipid and crude fiber contents with higher flavoids, saponins, cardiac glycosides and volatile oils contents compared to other spices examined. This study recommended the consumption of these spices in sufficient amount would contribute greatly to the human nutritional requirements. More research should be carried out on different types of spices to detects other phytochemicals.

Key words: Spices, Ginger, Garlic, Onion, Phytochemicals, Sokoto and Nigeria

1. Introduction

According to the Austrian Food Law, the term "spice" refers to plants or parts of plants (possibly dried) that are used to enhance the flavor or taste of human food [2]. Spices are often referred to as food accompaniments because of their ability to stimulate appetite and increase the flow of gastric juice. Spices not only just stimulate the taste buds but are composed of notable list of phyto-nutrients, essential oils, antioxidants, minerals and vitamins that are necessary for good health. The use of spices has been the tradition for many cultures since centuries, and now has become integral part of life. Although, spices are used in insignificant quantities, some researchers like Akpanyung, acknowledge that they also contribute to the nutrient content of the food. A research work by, also confirms that most seasonings are sources of nutrients [1]. Seasonings are ingredients which are added to foods to enhance their flavor. These ingredients include salt; herbs such as mint and thyme; spices such as chili powder and condiments such as mustard and vinegar. Apart from adding flavor to foods, some seasonings also contain medical and health benefits. Some of these benefits have been extensively studied while the potential of many are yet to be explored. Garlic, for instance, contains antioxidants, which help protect cells from damage caused by free radicals and also help to slow down the growth of tumor cells. The large quantities of sulphides present in garlic especially the bulb are antimicrobial and anti-inflammatory and therefore help to prevent or fight infectious diseases; as well as lower the levels of bad cholesterol and triglycerides in the blood. Ginger on the other hand is known for its antibiotic, anti-inflammatory, anti-clotting, anti-diarrheal, anti-cancer and anti-depressant activities. It has been used as a decongestant and its consumption has led to reduction in bad cholesterol.

Thyme is an expectorant and has antiseptic actions; lowers cholesterol levels; and eliminates scalp itching and flaking caused by candidiasis. Ginger is also being studied for its potential cancer-fighting and anti-inflammatory properties. Garlic acts as a catalyst for other herbs. It has antibacterial and antioxidant actions; it helps to ward off colds, sinus infections, and sore throats. It also helps to relieve arthritis and back pain. It burns calories since hot peppers in foods speed up metabolism. Other common examples of

seasonings include cinnamon, curry, onion, cinnamon, rosemary, parsley and sesame seeds. These spices are ground and packaged. In Nigeria, seasonings are manufactured as bouillon cubes and other well packaged powdery forms with different brand names. They contain salt, monosodium glutamate (MSG), and some spices as indicated by the manufacturers and are used extensively in food preparation in most homes and restaurants. Among the Hausas tribe in Nigeria, spices are used for soups especially for women who have just delivered. They are used to quicken the healing of the body processes. Such spices are produced locally by many households and used in generous amounts. The ingredients used in the production of the various seasonings sometimes depend on the preference of the producer or the health condition of the person.

Highest proportions of the rural and urban population resort to natural food ingredients, particularly because of their availability. Spices are a large group of such natural ingredients, and include dried seeds, fruits, roots, rhizomes, barks, leaves, flowers and any other vegetative substances used in a very small quantity as food additives to colour, flavor or preserve food [3]. Spices are fragrant, aromatic and pleasant. The bulk of the spices consist of carbohydrates such as cellulose, starch, pentosans and mucilage, and some amount of protein and minerals [4]. Only very small fractions of dry matter of the spices such as the phytochemicals are responsible for the flavoring, coloring, preservative and health-promoting characteristics [5]. Spices contribute very minimal nutrients to menu because they are used a very small amount. The bulk of the major components of spice materials consist of carbohydrate, protein and little minerals. Tannins, resins, pigments, volatile, essential and fixed oils which contribute to flavoring occur in traces and constitute only a small fraction of the dry matter [5].

Some well known spices of commerce include red pepper, onions, sage, ginger, nutmeg, clove, cinnamon, mustard, curry, turmeric, rosemary and garlic. Spices add flavor, relish and pungency to diets. Most spices are fragrant, aromatic and pleasant. Spices in food also exert such secondary effects as salt and sugar reduction, prevention of spoilage and improvement of texture [6]. Ginger can be available in different commercial products like cookies, candy, teas, tinctures, sodas, jam, beer, capsule and syrup [7]. The chief active constituents of ginger are Volatile oil (zingiberene, zingiberol, D-camphor), Shogaols, Diarylheptanoids, Gingerols, and Ginger flavonoids [8]. Garlic has been used to treat many conditions. The root bulb of garlic has been used traditionally for thousands of years to treat many disease conditions. The root bulb of garlic has a high concentration of sulfur containing compounds among which allicin appears to be among the most active compounds [9]. Garlic cloves are used for consumption (raw or cooked) or for medicinal purposes. They have a characteristic pungent, spicy flavor that mellows and sweetens considerably with cooking. Ginger (Zingiber officinale) is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine [10]. Raw ginger is chewed to stimulate the flow of saliva and to relax congested nostrils. Ginger tea is prescribed for cough, colds and influenza [11]. Onion powder is dehydrated, ground onion that is commonly used as a seasoning. It is a common ingredient in seasoned salt and spice mixes, such as beau monde seasoning. Some varieties are prepared using toasted onion. White, yellow and red onions may be used. Onion powder is a commercially prepared food product that has several culinary uses [12]. Onion powder can also be homemade.

These phytochemicals are plant metabolites which act as natural defense systems for host plants, and also provide characteristic colour, aroma and flavor in specific plant parts [13]. They are a group of non-nutrient compounds that are biologically active when consumed by human. Many phytochemicals are health-promoting and are of many disease preventive [3,14]. Both epidemiological and clinical studies have proven that phytochemicals present in cereals, fruits and vegetables are mainly responsible for reduced incidence of chronic and degenerative diseases among populations whose diets are high in these foods [12]. As a result there has been an increased search for phytochemical constituents that possess antioxidant and antibacterial potency in recent time [3,15]. Typical phytochemicals with antioxidant and antibacterial activities include polyphenols, phenolic acids and their derivatives, flavonoids, phospholipids, ascorbic acid, carotenoids and sterols. A number of exotic spices of international recognition with known Phytochemical constituents have been proven to be good natural antioxidants, antimicrobial and health-promoting agents [16,17,18]. Some of such internationally recognized spices include chili pepper, garlic, onion, anise, cinnamon, ginger, curry, rosemary and nutmeg [16].This research study aimed at investigating the Proximate and Phytochemical analysis of some Selected Spices (Garlic, Ginger and Onion) in Sokoto State.

2. Materials and Methods

2.1 Study Area

Sokoto is a city located in the extreme northwest of Nigeria, near the confluence of the Sokoto River and the Rima River. It occupies 25,973 square kilometers with a population of 563,861. Geographically situated between latitude 130˚.05 and 13˚.0830 north and longitude 05˚15 and 5.250˚ east with an average elevation of 272m above sea level [19]. The wet season lasts from June to September [20]. Annual rainfall ranges between 300mm and 800mm while mean annual temperature is 34^{O}C with dry seasons temperatures often exceeding 40^{O}C. Agriculture is the mainstay of the people. Major dry season vegetable crops which are mainly grown under irrigation include Ginger, Garlic, Onion, Tomato, Sweet and Hot pepper others include Carrot, Rice, and carrot [21].

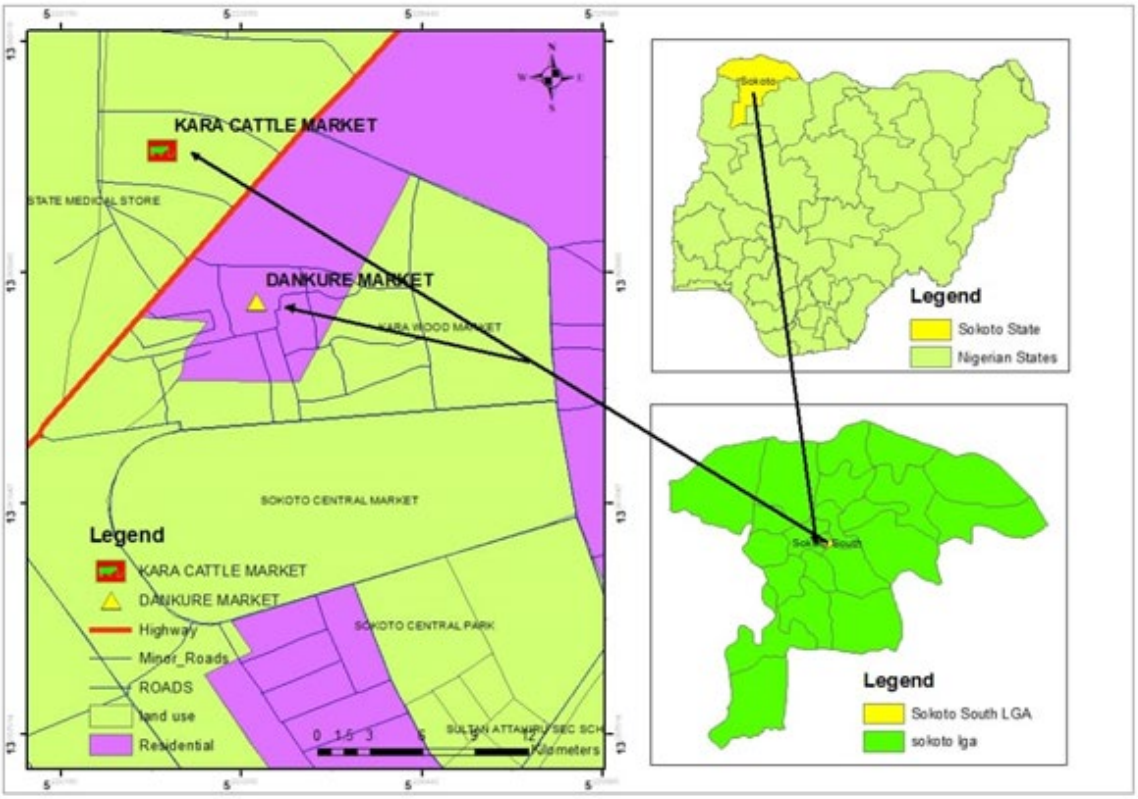

Figure 1: Map of Sokoto State showing the sample collection area

2.2 Collection of Samples

The three spices, Ginger (Zingiber officinale), Garlic (Allium sativum) and Onion ((Allium cepa L.) were obtained from Ramen Kura (Kara Market), and Dankure market, Sokoto, Nigeria. Spices were transported to Herbarium in the Department of Biological Sciences, Sokoto State University, Sokoto where they were stored at ambient temperature (26 ± 2 OC) until used.

2.3 Preparation of Spice Extracts

The three spices, Ginger (Zingiber officinale), Garlic (Allium sativum) and Onion ((Allium cepa L.) were sun-dried for 72h. They were then washed, chopped into pieces and oven-dried at 80ºC for 3hours and ground using blender till a uniform powdery form was achieved.

2.4 Extraction Procedure

The ethanolic extract of the samples were obtained by soaking 20g each of powdered samples of three spices, Ginger (Zingiber officinale), Garlic (Allium sativum) and Onion ((Allium cepa L.) in 100ml of ethanol in different air-tight, properly labelled glass containers. These were left undisturbed at a temperature of 28 ± 2°C for 120 hours (5 days). Thereafter the extracted samples were filtered with a clean white sieving cloth into separate 100 ml conical flasks. Further filtration was done for each sample using Whatman filter paper. The filtrates were then poured into separate 100 ml beakers and were appropriately labelled. Afterwards, the extracts were concentrated to 15ml by placing in an oven set at 45°C. Each concentrated extract was poured into different 3ml glass bottles, labelled and the yield of each extract was then subjected to qualitative phytochemical screening [5].

2.5 Proximate Analyses

Moisture, crude protein, fat, ash and fiber contents were determined for each samples by the Association of Official Agricultural Chemists [22].

• Determination of Moisture Content

3 g of the fresh sample of each plant material were placed in the crucible and heated at 105˚ C until a constant weight was attained. The moisture content of each variety was calculated as loss in weight of the original sample and expressed as percentage moisture content [22].

• Determination of Ash Content

The total ash content of a substance is the percentage of inorganic residue remaining after the organic matter has been ignited. 3g of the pulverized plant samples was placed in a crucible and ignited in a muffle furnace at 550oC for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash [22].

• Determination of Crude Lipid

This estimation was performed using the Soxhlet extraction method. 5 g of the powdery form of each plant sample were weighed and wrapped with a filter paper and placed in a thimble.

The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. 200 ml of n – hexane was used to extract the lipid [22].

2.6 Determination of Crude Fiber

Five grams of the powdery form of each plant material and 200 ml of 1.25 % H2SO4 were heated for 30 min and filtered with a buchner funnel. The residue was washed with distilled water until it was acid free. 200 ml of 1.25% NaOH was used to boil the residue 30 minutes; it was filtered and washed several times with distilled water until it was alkaline free. It was then rinsed once with 10% HCl and twice with ethanol. Finally it was rinsed with petroleum ether three times. The residue was put in a crucible and dried at 105o C in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace at 550o C for 60 minutes to obtain the weight of the ash [22].

2.7 Determination of Carbohydrate

The carbohydrate content was determined by subtracting the summed-up percentage compositions of moisture, protein, lipid, fiber, and ash contents from 100 [23].

2.8 Phytochemical Analysis (Qualitative Analysis)

• Test for Flavonoids

The presence of flavonoids in the samples was determined by the acid alkaline test method. 3g of the plant sample was put into test tube and a few drops of concentrated ammonia solution added to it. A yellow coloration was found which turned colorless when few drops of concentrated hydrochloric acid gas added to it showing the presence of flavonoid in the sample [24].

• Test for Tannins

The presence of tannins in the samples was determined using the method described by [25]. 2g of the sample was soaked in 10 ml of methanol. After 24 hours, it was filtered using what man filter paper (No 1). 2ml of the extract was mixed with a dilute ferric chloride solution. A greenish black precipitate was formed indicating the presence of tannins [24].

• Test for Saponins

The presence of saponin in the samples was determined by the method described by [26] 3g of powdered sample was mixed with 5ml of distilled water in a test tube. The mixture was shaken vigorously. A stable froth (foam) on standing indicates the presence of saponin. In the emulsion test, 3 drops of groundnut oil was added to 2g of sample and was mixed with 5ml of distilled water and shaken well. Formation of emulsion indicates the presence of saponin [24].

• Test for Glycosides

25ml of dilute sulphuric acid was added to 5ml of extract in a test tube and boiled for 15 minutes, cooled and neutralized with 10% NaOH, then 5ml of fehling solution A and B was added. A brick red precipitate of reducing sugars indicates presence of glycosides [24].

• Test for Alkaloids

The presence of alkaloid in the test sample was carried out using the Mayer and Wagner test and was described by Harbune [27]. 2g of the powdered sample was put into a conical flask and 10 ml of absolute ethanol (98%) was added into the flask. After shaking vigorously for about 30 minutes, it was filtered and the filtrate was used as the extract. The formation of an orange coloration indicated the presence of alkaloids [24].

• Test for Cardiac glycosides

To 0.5 g of extract diluted in 5 ml of water was added 2 ml of glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1 ml of concentrated sulphuric acid. A brown ring at the interface indicated the presence of a deoxy sugar characteristic of cardenolides. A violet ring may appear below the brown ring, while in the acetic acid layer a greenish ring may form just above the brown ring and gradually spread throughout the layer [24].

• Test for steroids

0.2 g of plant extract and 2 mL of chloroform were added together, 2ml of concentrated sulphuric acid was added to form a layer. The formation of a violet/blue/green/reddish-brown ring at the interface indicates the presence of steroidal ring [24].

• Test for Saponin glysides

2.5ml of the extracts was added to 2.5ml of fehling solution A and B, a blueish green precipitate showed the presence of saponin glycosides [28].

• Test for Balsams

0.2 g of plant extract and 2 ml of ethanol were mixed together and two drops of alcoholic ferric chloride solution was added. A dark green coloration indicates the presence of balsams [24].

• Test for Anthraquinones

0.2 g of plant extract and 5 mL of chloroform were mixed, shaken together for 5 minutes. The mixture was filtered. 2.5 ml of 10% ammonium hydroxide was added to the filtrate. A bright pink, red or violet colour at the upper layer indicates free anthraquinones [24].

• Test for volatile oils

2.0ml of extract solution was shaken with 0.1 ml dilute sodium hydroxide and a small quantity of dilute HCl. A white precipitate was formed with volatile oils [24].

2.9 Statistical Analysis

The results was analyzed in simple descriptive data analysis.

3. Results

3.1 Proximate Analysis

Using conventional method, the result of proximate analysis of Garlic, Ginger and Onion to determine the moisture, Ash, Lipid and Carbohydrate contents in this research revealed that, Onion had the highest contents of Moisture 11.50%, followed by Ginger 11.00% and the least was Garlic with 8.14%. Ginger had the highest content of Ash 7.00% followed by Onion 5.50% and the least was Garlic with 1.39%. In Lipid, Garlic had the highest content of 46.48%, followed by Onion with 14.50% and the least was Ginger with 4.50%. The Fiber shows that Garlic had the highest content of 27.39%, followed by Ginger 22.00% and the least was Onion with 9.50%. Onion had the highest Carbohydrate content of 51.50%, followed by Garlic 49.90% and the least was Ginger 20.01%.

These shows that, in the three spices investigated, Carbohydrate had the highest content of 51.50% and 49.09% in Onion and Garlic, followed by Lipid 46.48% in Garlic and the least was Ash Table 1.

Nutrients (%0)	Samples		
	Garlic	Ginger	Onion
Moisture	8.14	11.00	11.50
Ash	1.39	7.00	5.50
Lipid	46.48	4.50	14.50
Fiber	27.39	22.00	9.50
Carbohydrate	49.9	20.01	51.50

Table 1: Proximate Analysis Result (Garlic, Ginger and Onion)

3.2 Phytochemical Analysis

The result of Phytochemical analysis on three spices (Garlic, Ginger and Onion) in this research shows that eleven Phytochemicals was identified in moderate and trace amount. The Phytochemicals investigated are flavonoids, Tannins, Saponins, Glycosides, Alkaloids, Cardiac Glycosides, Steroids, Saponin Glycosides, Balsams, Anthraquines and Volatile Oils.

Garlic contains high amounts of Flavonoid, Saponin, Cardiac Glycosides and Volatile oils. Tanins, alkaloids, Glycosides steroids and Anthraquines were in moderate amount. Saponin glycosides and balsams were not detected. In Ginger, high amount of Saponin was observed compare to other constituents. Flavonoid, Glycosides, Alkaloids, Cardiac Glycosides, Balsams and Volatile oils were in moderate amount. Tanins, Steroids Saponin and Anthraquines were not detected. In Onion, Tanins, Glycosides and Alkaloid had the highest amounts. Saponin steroid, Saponin glycosidase and Anthraquines were absent Flavonoid, Cardiac glycosides, Balsams, Volatile oils were in moderate amount.

Constituents	Samples		
	Garlic	Ginger	Onion
Flavonoids	++	+	+
Tannins	+	—	++
Saponins	++	++	—
Glycosides	+	+	++
Alkaloids	+	+	++
Cardiac Glycosides	++	+	+
Steroids	+	—	—
Saponin glycosides	N.D	N.D	—
Balsams	N.D	+	+
Anthraquines	+	—	—
Volatile oils	++	+	+
++ = High amounts, + = Moderate amounts, — =Absent, N.D = Not detected			

Table 2: Phytochemical Analysis of some Selected Spices Garlic, Ginger and Onion

4. Discussion

This study was carried out to evaluate the proximate and phytochemicals to ascertain their compositions of some selected spices; Garlic ginger and Onion. The proximate composition analysis (table 1) showed presence of moisture content ranging from 11.00 for ginger to 11.50 for Onion. Okwu, had earlier posited that such differences may arise from variations in soil and it could also be partly attributed to the method of analyses [29]. Moisture content of any food is an index of its water activity. The high moisture content provides for greater activity of water-soluble enzymes and co-enzymes needed for metabolic activities of these plants [30]. The low moisture contents is indicative of the fact that it can be stored for a long time without deterioration in quality. The ash content ranged ranged from 1.39 for garlic to 7.00 for ginger.. However, the value for the ash content conforms with that reported [31]. This means that the spices have good mineral content, and thus serves as a viable tool for nutritional evaluation. The crude lipid content ranged from 4.50 for Ginger to 46.48 for garlic. The

lipid level investigated were within range as the results obtained from other spices seeds as was reported by Erukainure [32]. The high lipid content is indicative of the fact that garlic is a good source of flavor since it is rich in essential oil and this also suggests possible sources of oil soluble vitamins. The crude fiber content ranged from 9.50 for Onion to 27.39 for garlic. The percentage of crude fiber was noticed to be higher in garlic (27.39%) which contradicted the reported 10.47% by Okonkwo [33]. The crude fiber help to prevent many metabolic or digestive disorders such as constipation and irritable bowels. And finally, the carbohydrate content ranged from varied considerably, ranging from 20.01 for garlic to 51.50 for Onion. Documented a carbohydrate content of ranging from 46.22% to 52.50% for Onion which conforms to the present study [1]. Found that garlic possessed a carbohydrate level of 19.43% which approximately conforms to this study [34]. However, the high carbohydrate content observed in Onion suggests its high caloric value and is indicative of its high sugar concentration compared to other spices. The phytochemical active compounds of three selected spices i.e., Garlic ginger and Onion were qualitatively analyzed separately and the results are presented in the Table 2.

The phytochemicals contents (Table 2) identified were; flavonoids, tannins, saponins, glycosides, alkaloids, cardiac glycosides, steroids, saponin glycosides, balsams, anthraquines and volatile oils. Garlic showed high number of phytochemicals content of flavonoid, saponin, cardiac glycosides and volatile oils compare to the other spices analyzed. It is also in agreement with earlier report on spices been high in saponin, flavonoids, cardiac glycosides, volatile oils and tanins [32]. The use of this chemical in the treatment of tumor has been significant in most reports which suggests the exploitation of the spices in this regard and might be beneficial [35]. In ginger, only saponin contains high amounts compare to other constituents.

This finding is in conformity with the work of where saponins was found in abundance in the seed of fresh ginger [36]. In their report, wider range of different phytochemicals were analyzed in which saponins content was higher than most phytochemicals. In Onion, Flavonoid, cardiac glycosides, balsams, volatile oils were in moderate amount and that agrees with earlier report carried out by Osibite, on anti-malaria activity of essential oil from the seed of onion [37]. Many evidences gathered in earlier studies confirmed the identified phytochemicals to be bioactive. In addition, several studies discussed earlier herein, confirmed the presence of these phytochemicals and they contributed to medicinal as well as physiological properties to the plants studied in the treatment of different ailments such as antifungal, antiviral, antibacterial, anti-inflammatory and anticarcinogenic activity. Difference phytochemicals has been found to possess a wide range of activities, which may help to protects against chronic diseases such as heart diseases and stroke, saponins protects against hyper chlolesterolemia and antibiotics properties [38]. However, according to, a glycoside appeared to be the major bioactive component that offers antisecretory and antiulcer effects [39].

5. Conclusion

The study showed that the spices selected; Garlic, Ginger and Onion possess considerable amount of constituents and phytochemicals. All spices recorded varying proportions of the proximate components as well as phytochemical contents. However, garlic possessed more crude lipid and crude fiber contents with higher flavoids, saponins, cardiac glycosides and volatile oils contents compared to other spices examined. Therefore, if consumed in sufficient amount would contribute greatly to the human nutritional requirements for normal growth and adequate protection against diseases arising from malnutrition.

Recommendations

• Based on this study, consumption of these spices in sufficient amount would contribute greatly to the human nutritional requirements.

• The presence of these Phytochemical contributes in the treatment of different ailments.

• More research should be carried out on different types of spices to detect other Phytochemical.

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