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Evaluation of Nutritional Composition and Antioxidants Properties of Onion (*Allium Cepa*) and Garlic (*Allium Sativum*)

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Abstract:
Two among commonly consumed spices all over the world, Onion (Allium cepa) and Garlic (Allium sativum) were examined for the proximate composition, mineral composition and antioxidant properties using standard methods. Proximate composition (%) of Allium Cepa and Allium Sativum were; moisture (16.23 ±0.1 and 12.14 ±0.05), crude fat (2.96 ±0.09 and 5.98 ±0.13), crude fibre (5.90 ±0.02 and 2.23 ±0.09), ash (5.58 ±0.02 and 3.71 ±0.01), crude protein (12.53 ±0.37 and 15.82 ±0.29), carbohydrate (58.67 ±0.56 and 58.25 ±0.84) and dry matter (83.77 ±0.08 and 87.86 ±0.05) respectively. The mineral composition (mg/100g) of the Allium cepa and Allium sativum respectively are; sodium (40.67 and 38.67), calcium (289.69 and 270.72), potassium (90.25 and 83.70), magnesium (8.33 and 7.90), iron (2.65 and 2.49), zinc (1.78 and 1.69), copper (0.67 and 0.52), manganese (0.61 and 0.55) while lead and cadmium were not detected in the samples. The result of the antioxidant properties showed that Allium cepa and Allium sativum contains; Total flavonoid (0.71 ±0.05 and 0.78 ±0.05) mg/g, total phenol (8.86 ±0.02 and 8.11 ±0.04) mg/g, Ferric Reducing Antioxidant Power (FRAP) (15.61 ±1.26 and 50.75 ±0.15) mg/g, 1,1-diphenyl-2-picryl-hydrazyl (DPPH) (75.17 ±0.03 and 22.63 ±0.54) mg/g and Fe^{2+} chelation (30.28 ±0.46 and 38.07 ±2.29) mg/g respectively. The results revealed that the spices are good source of nutrients, minerals, and antioxidants. Therefore, their use as nutritional supplements is highly promising.

Keywords: *Nutritional composition, Antioxidants, Allium Cepa, Allium Sativum*

1. Introduction

Spices have nutritive and antioxidant properties which make them important as food and medicine. They bring out the unique natural taste in foods and could be used to change the look of food to make it more attractive in colour. Some of them grow in the wild and are very good source of food preservatives especially for industrially processed foods (Ambuja, *et al.,* 2015). Examples of spices range from Onion, Garlic, Ginger, Cloves, Cumin, Nutmeg, Pepper and Fennel. *Allium* species, which is the most important genus of the *Alliaceae* family, are among the oldest cultivated vegetables. They have been used as ornamentals, spices, vegetables, or as medicines for curing various diseases. The *Allium* genus includes more than 700 species widely distributed all over the world (Tepe *et al.,* 2005) and appreciated due to their flavor, easy growth and storage time. The species however differ in form of taste, but they are close in biochemical and phytochemical contents. *Allium* species are characterized by their rich sulphur compound content that are responsible for organoleptic parameters (Lanzotti, 2006) and contribute to the antioxidant activities of these vegetables (Yin and Cheng 2003). These volatile components also constitute the major part of the essential oils of these plants (Iranshashi, 2012).

Garlic (*Allium sativum*) and onion (*Allium cepa*) are the most important *Allium* species consumed all over the world. The major compound present in onion essential oils are dipropyl disulfide and dipropyltrisulfide (Kim *et al.,* 2004) and they have been reported to have antimicrobial and antioxidative activities (Ye *et al.,* 2013). The Mediterranean diet which traditionally includes generous amount of fruits and vegetables has been associated with health benefits such as lower risk for cardiovascular disease (CVD) and cancer (Maria and Roldán 2009). There is epidemiologic evidence that frequent consumption of *Allium* vegetables such as garlic, onion, scallions, chieves are protective against cancer. Therefore, *Allium* vegetables are considered an important component of a healthy, cancer and Cardiovascular disease (CDV) resistant diet.

They are bulbous vegetables that are grown mainly as food materials. They are highly valued for their flavor and for their nutritional value. In Nigeria, onion (*Allium cepa*) is consumed in its tender state, raw, ripe, pickled or in form of powder. The bulbs can also be boiled and used as soups and stews recipe, fried or eaten raw. They can also be preserved in the form of pickles. Onion leaves are also used in preparation of salads and soups. Garlic on the other hand is used mainly as flavor in food. In view of the high rate of cancer and cardiovascular related diseases in the country, it is essential to source for alternative, inexpensive and natural spices such as onion, garlic and other spices to replace the existing expensive medicines. *Allium cepa* and *Allium sativum* contained natural flavor, high moisture content, high carbohydrate, nutritionally valued minerals, natural occurring antioxidants (Ambuja, *et al.,* 2015). This research is therefore aimed at evaluation of the nutritional composition and antioxidant properties of the selected spices.

2. Materials and Methods

2.1. Samples and Samples Preparation

Samples of Onions (*Allium cepa L*) and Garlic (*Allium sativum*) were purchased at Oja Oba Market in Akure, Ondo State, Nigeria and brought to the laboratory. The purchased raw onion bulbs and garlic were examined and separated by hand picking to remove bad ones; those without any physical defect were selected for analysis. The outer skin and ends of the onions and garlic samples were removed and washed in running tap water first, then in distilled water, to remove adhering debris. The samples were sliced into chips and sundry, the dried samples were ground using electric malex blender to obtain homogenous (fine) powder. The ground samples were kept in air tight containers, clearly labeled for better identification and stored in the fridge at 4 ^{o}C prior analysis. The ground samples were extracted using distilled water as solvent to obtain clear extract which was later analyzed for antioxidant properties.

2.2. Proximate Analysis

Proximate analyses such as moisture, crude protein, ash, crude fibre and crude fat were carried out in accordance with standard methods of Association of Official Analytical Chemists (AOAC, 2000). Total carbohydrates and total dry matters were estimated by difference: 100 – (% ash + % crude protein + % fat + % crude fibre + % moisture) and 100 – (% moisture) respectively.

2.3. Mineral Analysis

About 2.0 g of the sample was ashed by putting the sample in a dish and heated in a furnace at 550 ^{o}C until all the carbon was burnt away. The crucible plus ash was transferred to a desiccator 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 latter filtered using filter paper into 100 ml volumetric flask and made up to the mark with distilled-deionized water. Atomic Absorption Spectrophotometer (Bulk scientific, 210VGP) was used for the analysis of the following metals; Ca, Mg, Fe, Zn, Cu, Mn, Pb and Cd while Na and K were determined with flame photometer (FP902PG).

2.4. Evaluation of Antioxidant Properties

Total phenol, total flavonoid, ferric reducing property, free radical scavenging ability (1, 1- diphenyl-2-picryhydrazyl) and Fe^{2+} Chelation were determined using standard method developed by; (Singleton *et al.,* 1999, Bao *et al.,* 2005, Pulido, *et al.,* 2002, Gyamfi *et al.,* 1999 and Puntel *et al.,* 2005) respectively.

3. Results and Discussion

Parameters (%)	*Allium cepa* Onion	*Allium sativum* Garlic
Moisture	16.23 ± 0.1	12.14 ±0.05
Ash	5.58 ±0.02	3.71 ±0.01
Crude Fibre	5.90 ±0.02	2.23 ±0.09
Crude Fat	2.96 ±0.09	5.98 ±0.13
Protein	12.53 ±0.37	15.82 ±0.29
Carbohydrate	58.67 ±0.56	58.25 ±0.84
Dry Matter	83.77 ±0.08	87.86 ±0.05

Table 1: Proximate Composition (%) of Allium cepa and Allium sativum bulbs
Mean ± standard deviation of triplicate determinations

3.1. Proximate Composition

Table 1 shows the proximate composition of Onion bulb (*Allium cepa*) and Garlic bulb (*Allium sativum*). The moisture content of *Allium cepa* (16.23 %) was higher than that of *Allium sativum* (12.14 %) which are higher than the moisture contents of spices such as Ginger (4.88 %) and *Ashanti Pepper* (6.10 %) reported by (Nwinuka, *et al.,* 2005). It has been established through various research that food with low moisture content (especially those with less than 10 %) have longer shelf-life with limited deterioration in quality due to microbial activities, but those with moisture content higher than 10 % cannot be stored for long period of time (Nwinuka *et al.,* 2005). This implies that Ginger and *Ashanti Pepper* can be store for a longer time without spoilage than Onion and Garlic. The result in Table 1 also shows that Onion deteriorate faster than Garlic. The crude fat of *Allium cepa* (2.96 %) is lower compared to that of *Allium sativum* (5.98 %). *Allium cepa* shows low fat content than Ginger (5.53 %) and *Ashanti Pepper* (12.50 %). However, *Allium*

sativum have higher fat content than Ginger (5.53 %) but lower content than *Ashanti Pepper* (12.50 %) as reported by (Nwinuka *et al.,* 2005). This does not, however, portray Ashanti Pepper as an oil seed. *Allium cepa* (5.90 %) contains higher crude fibre than *Allium sativum* (2.23 %). *Allium cepa (*5.90 %*)* contains higher crude fibre than Ginger (3.05 %) as reported by (Okolo *et al.,* 2012) and lower crude fibre than Ashanti Pepper (6.05 %) reported by (Armand *et al.,* 2012), on the contrary, *Allium sativum* contains lower crude fibre than both Ginger (3.05 %) and Ashanti Pepper (6.00 %) reported by (Okolo *et al.,* 2012). Crude fibre help in maintenance of normal peristaltic movement of the intestinal tract hence, it helps in digestion of food. Higher fibre content in onion makes it suitable for recommendation for patients who have problems with food digestion. (Okolo *et al.,* 2012). Proteins are essential component of the diet needed for the survival of animals and human, they serve as source of nitrogen in the body system along with the amino acids. Good skin, increase in growth and ability to replace the worn-out cells are the quality of protein in the body (Okolo, *et al.,* 2012). Both samples *Allium cepa* and *Allium sativum* had protein concentration below 20 %. These ranged from (12.53 %) in Onion to (15.82 %) in Garlic. The protein content of these two seeds was higher than those reported by (Nwinuka *et al.,* 2005) for Ginger (8.58 %) and Ashanti Pepper (12.50 %). It can be concluded that the protein content of the two samples *Allium cepa* and *Allium sativum* cannot be used as a good source of protein since it is less than 20 %. Onion had the highest concentration of ash (5.58 %) compared to that of Garlic which had ash concentration of (3.71 %). High ash content is an indication of high inorganic mineral content (Oloyede, 2005). This indicates that onion is richer in inorganic minerals than garlic. Ginger (6.40 %) and Ashanti pepper (4.45 %) both have higher ash content than garlic (3.71 %) while onion have lower ash content compared to ginger but higher than that of Ashanti pepper as reported by (Nwinuka *et al.,* 2005). The highest value of all the parameters determined was the total carbohydrate composition. There was no significant difference in carbohydrate content of the two samples, with *Allium cepa* (58.67 %) and *Allium sativum* (58.25 %). The high carbohydrate content in these spices is nutritionally desirable as its deficiency may cause depletion of the body tissue. The result shows that the two spices (*Allium cepa and Allium sativum)* can be used as a good source of energy. The two spices are low in carbohydrate when compared with that of Ginger (72.84 %) and *Ashanti Pepper* (67.59 %) reported by (Nwinuka *et al.,* 2005).

Minerals (mg/100g)	***Allium cepa* Onion**		***Allium sativum* Garlic**	
Sodium (Na)	40.67		38.67	
Potassium (K)	90.25		83.70	
Calcium (Ca)	289.69		270.72	
Magnesium (Mg)	8.33		7.90	
Iron (Fe)	2.65		2.49	
Zinc (Zn)	1.78		1.69	
Copper (Cu)	0.67		0.52	
Manganese (Mn)	0.61		0.55	
Lead (Pb)	BDL		BDL	
Cadmium (Cd)	BDL		BDL	
BDL: Below Detection Limit				

Table 2: Mineral Composition (mg/100g) of Onion (Allium cepa) and Garlic (Allium sativum)

3.2. Mineral Composition of Allium cepa and Allium sativum bulbs

The mineral composition of *Allium cepa* and *Allium sativum* bulbs are presented in Table 2. Calcium was the most abundant mineral in both *Allium cepa* (289.69 mg/100g) and *Allium sativum* (270.72 mg/100g) respectively; these are higher than the nutmeg (37.5 mg/100g) reported by (Armand *et al.,* 2012). They are also noted to be higher than the calcium in ginger (25.76 mg/100g) reported by (Gloria *et al.,* 2010). Calcium helps in building of bones, blood clothing, muscles contraction and in certain enzyme in metabolic processes, excess calcium can cause magnesium deficiency (Ozcan, 2004). He also reported that calcium in conjunction with phosphorus, magnesium, manganese, vitamins A, C & D, chlorine and protein are all involve in bone formation. WHO/FAO recommend about 1200 mg/day for age 24 and below while for adult, it is between the ranges of 400 – 500 mg / day. Potassium was also high in the two spices with *Allium cepa* (90.25 mg/100g*)* and *Allium sativum* (83.70 mg/100g). Gloria *et al.,* (2010) reported (229.00 mg/100g) for Ashanti pepper which is higher than those of Garlic and Onion. 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 (Oloyede, 2005). Sodium concentration of both spices were *Allium cepa (*40.67 mg/100g*)* and *Allium sativum* (38.67 mg/100g), 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 (Umoh *et al.,* 2014). This shows that onion and garlic are good for consumption as it contains low level of sodium. Magnesium is an activator of many enzymes in the body system and maintains the electrical potential of nerves (Osabo *et al.,* 2015). Magnesium concentration in both spices was *Allium sativum* (8.33 mg/100g*)* and *Allium cepa* (7.90 mg/100g*).* The concentration of magnesium in the two spices was relatively high compared with other spices such as Ginger (5.00 mg/100g), Ashanti pepper (4.50 mg/100g). 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. Iron concentration in both spices were *Allium cepa* (2.65 mg/100g) and *Allium sativum* (2.49 mg/100g). These are lower compared to the reported value of iron in *Pipper guineese* (21.8 mg/100g) (Ozcan, 2004). Iron is required for the formation of blood cells and its deficiency causes anaemia (Umoh *et al.,* 2014). The iron contents of 2.65 mg/100g obtained in the onion and 2.49 mg/100g in garlic are lower than the quantity of iron required in the body

4.50g. Low Iron concentration in the blood can leads to tiredness and fatigue (Umoh *et al.,* 2014). Zinc is an essential trace element in the human body, it is found in high levels in the red blood cells as an essential part of the enzyme carbonic anhydrate which promotes many reactions relating to carbon dioxide metabolism. 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 (Okaka and Okaka, 2001). Zinc concentrations in both spices were *Allium cepa* (1.78 mg/100g*)* and *Allium sativum* (1.69 mg/100g), these are moderate enough for the management of diabetes. Manganese concentration of the two spices were *Allium cepa* (0.61 mg/100g) and *Allium sativum* (0.55 mg/100g), 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 (Osabo *et al.,* 2015). The relative low level of this element in both *Allium cepa* (0.61 mg/100g) and *Allium sativum* (0.55 mg/100g) is of benefit to its consumption. Copper concentration of the two spices was *Allium cepa (*0.67 mg/100g*)* and *Allium sativum* (0.52 mg/100g). The copper concentration of ginger (25.10 mg/100gDM) reported by (Osabo *et al.,* 2015) was higher than the two spices. Copper combines with certain proteins to produce enzymes that act as catalysts to help a number of body system functions, some help to provide energy required for biochemical reactions. It also helps in the transformation of melanin for pigmentation of the skin. Research suggests that copper deficiency is one factor leading to an increased risk of developing coronary heart disease (Osabo *et al.,* 2015). 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 (Altura and Altura, 1999). They also regulate the fluid balance of the body thereby influence cardiac output. Literature also revealed that a lower than normal dietary intake of Mg can be a strong risk factor for hypertension, cardiac arrhythmias, ischemic heart disease, atherogenesis and sudden cardiac death (Altura and Altura, 1999). 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 (Okwu, 2005). The importance of these elements cannot be overemphasized because they are required by many enzymes as co-factors (Ozcan, 2004).

The non-detection of Lead (Pb) and Cadmium (Cd) is of great advantage to consumers of these spices as these elements have been reported to be highly toxic even at low concentrations (Oloyede, 2005).

Antioxidants	Onion(mg/g)	Garlic (mg/g)
Total flavonoid	0.71 ±0.05	0. ±0.045
Total phenol	8.86 ±0.02	8.110 ±0.04
FRAP	15.61 ±1.26	50.75 ±0.15
DPPH	75.17 ±2.03	22.63 ±0.54
Fe^{2+} chelation	30.28 ±0.46	38.07 ±2.29

Table 3: Antioxidant Properties (mg/g) of Allium cepa (Onion) and Allium sativum (Garlic)
Mean ± Standard deviation of triplicate determination.

3.3. Antioxidant Properties of Allium

Table 3 shows the antioxidant properties of *Allium cepa (*Onion*)* and *Allium sativum* (Garlic). Total phenolic content in the aqueous extract of *Allium cepa* and *Allium sativum* were (0.71 mg/g and 0.78mg/g) respectively. *Allium sativum* have higher content of total phenol than *Allium cepa*. Polyphenol compound are commonly found in both edible and medicinal plants and they have been reported to have various biological effects including antioxidant activity. The antioxidant activities of phenolic content of spices is mainly due to their redox properties, which can play an important role in absorbing and neutralizing free radicals, quenching singlet and triplet oxygen or decomposing peroxides (Gulcin *et al.,* 2003). Phenolics are the largest group of phytochemicals and have been touted as accounting for most of the antioxidant activity of plants and spices. Flavonoids represent the most common and widely distributed groups of plant spices phenolics. They are potent water soluble super antioxidants that function in scavenging free radicals, inhibition of peroxidants and chelating transition metals (Nickavar *et al.,* 2007). The result shows that *Allium cepa* (8.86 mg/g) has higher total flavonoid content than *Allium sativum* (8.11 mg/g). The amount of Total flavonoids was higher in *Allium cepa* and *Allium sativum* compared to that of ginger (2.98mg/g) as reported by (Shirin and Jamuna, 2011). This shows that Onion and Garlic has higher flavonoid contents than ginger and Ashanti pepper. The result also shows that Fe^{2+} chelation antioxidant property was higher in *Allium sativum* (38.07 mg/g) than that of *Allium cepa* (30.28 mg/g). The presence of antioxidants in the samples would result in the reduction of Fe^{3+} to its lower valence state, Fe^{2+} by donating an electron. Amount of Fe^{2+} complex can then be monitored by measuring the formation of Perl's Prussian blue at 700nm. Increasing absorbance at 700nm indicates an increase in reductive ability (Ebrahimzadeh *et al.,* 2010). The result obtained for *Allium cepa* and *Allium sativum* extracts confirm that Fe^{3+} - Fe^{2+} transformation occurred in the presence of the extracts, thereby confirming their antioxidant potentials. The result in Table 4.4 also shows that *Allium cepa* has higher DPPH (75.17 mg/g) radical inhibition than *Allium sativum* (22.63 mg/g). The concentration of DPPH in *Canarium schweinfurthii* fruit was reported to be 17.28 mg/g (Ayoade *et al.,* 2015) which was lower than the two spices investigated. DPPH radical scavenging assay provides easy, rapid and convenient method to evaluate antioxidants and radical scavengers (Roginsk *et al.,* 2005). This is based on the ability of 1,1-diphenyl-2-picryl-hydrazyl (DPPH) which is a stable free radical, to decolorize in the presence of antioxidants. DPPH radical contains an odd electron, which is responsible for the absorbance at 515nm and also responsible for the visible deep purple colour. When DPPH accepts an electron donated by an antioxidant compound, the DPPH is decolorized and this effect can be quantitatively measured from the changes in absorbance (Saha *et al.,* 2008). The result of Ferric reducing antioxidant power (FRAP)

in *Allium cepa* (15.61 mg/g) was lower than that of *Allium sativum* (50.75 mg/g). This shows that the extract of the samples had good potential to reduce the ferric ions into ferrous ions, which is a measure of antioxidant activity.

4. Conclusion

The result of the proximate analysis showed high moisture content for the two samples, this implies that they cannot be stored in raw form for a long time, but can be sun dried or keep in the refrigerator to increase the shelf life. The present study has shown that the spices contain moderate amounts of fat and protein which are nutrients needed by the body. The ash contents suggest that they are good sources of nutritional minerals. They are high in carbohydrate (CHO/ NFE); this implies that they are good supplements where energy given food is required. Onion is rich in fibre and can be used in digestion and circulation aiding food processing. The two spices are rich in calcium which is useful for building strong bones in the body system. The absence of toxic metals such as Lead and Cadmium shows that the intake of these spices poses no threat to human health. The result show high antioxidant properties, hence it can be concluded that the high antioxidant properties indicate their potential usefulness in human as medicinal food. Since free radicals are responsible for many diseases such as cancer, inflammatory, tumor etc. Antioxidants also help to protect the skin from sun exposure and decrease skin roughness, wrinkles depth, ultraviolet induced skin cancer and skin swelling from sunlight; hence, these spices may find usefulness in the body lotion industry. There is need for proper orientation on the necessity of proper intake of these spices which will definitely supply the much-needed antioxidants and minerals. There was an indication from the result that the spices are good source of nutrients, minerals, and antioxidants. The results of the analysis hereby recommend that more cultivation of these spices should be encourage, technical preservation method should be developed since the two spices contain high moisture content making them perishable, the consumption of these spices should also be encouraged since they contain high antioxidant properties which prevent many diseases.

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