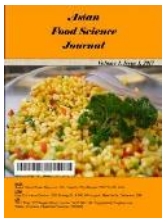

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Nutritional Composition and Phytochemical Analysis of Aqueous Extract of *Allium cepa* (Onion) and *Allium sativum* (Garlic)

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Authors' contributions

This work was carried out in collaboration between all authors. Author MHD designed the study. Author FAA wrote the first draft of the manuscript. Authors MHD and FAA performed the statistical analysis. Author MHD wrote the protocol. Authors MHD and MM managed the analyses of the study. Authors FAA and MM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Allium cepa (onion) and *Allium sativum* (Garlic) are commonly used as spice in food preparation and source of nutrient around the globe. Additionally, they are used in the treatment of several diseases associated with metabolism. In this study phytochemical constituent, proximate analysis, mineral and vitamin compositions of both *Allium cepa* and *Allium sativum* were analysed using standard analytical procedures and atomic absorption spectroscopy (AAS). Proximate analysis revealed a significant difference ($P<0.05$) in the moisture content, Ash content, crude fibre, protein, carbohydrate, and lipid contents in both extracts. However, these extracts showed no significant difference ($P>0.05$) in the minerals compositions i.e. manganese, copper, Iron and magnesium except calcium where the significant difference ($P<0.05$) was observed. A significant difference ($P<0.05$) was seen in antioxidant vitamins (A, C and E) in both extracts. In conclusion, the rich

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nutritional contents present in *Allium cepa and Allium sativum* might be the reason why these spices are used in the management and prevention of several nutritionally related diseases and disorders.

Keywords: Allium cepa; Allium sativum; antioxidants; nutrition; phytochemicals.

1. INTRODUCTION

In Nigeria, a high proportion 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 which include dried seeds, fruits, roots, rhizomes, barks, leaves, flowers and any other vegetative substances used in a very small quantity as an additive to colour, flavour or preserve food [1]. Spices are fragrant, aromatic and pleasant, the bulk of spices consist of carbohydrates such as cellulose, starch, pentosans and mucilage, with some amount of protein and minerals [2]. Only small fractions of dry matter of the spices such as the phytochemicals and vitamins are responsible for the flavouring, colouring, preservation and health-promoting characteristics [3].

The Allium family has over 500 members, each differing in taste, form and colour, but similar in biochemical, phytochemical and nutraceutical contents [2-3]. *Allium cepa and Allium sativum* were some of the first cultivated crops due to their long storage and portability. They could be dried and preserved for several months [3]. *Allium cepa* and *Allium sativum* are one of the most popular spices in the world. They can be consumed raw or cooked. Alliums were revered to possess antibacterial and antifungal activities, and contain active antioxidants, sulfur and other numerous phenolic compounds which arouse great interests [3-4].

Both *Allium cepa and Allium sativum* contain varieties of natural chemicals that are capable of fighting infections and healing the human body [4]. Ancient people were aware of the medicinal value of both Allium as they consumed them regularly in order to protect themselves from illness and also faster recovery from infection [3]. Several studies reported the significance of *Allium cepa and Allium sativum* as worthy of used as food regularly to provide optimum health benefits. Regardless of the pungent odour they produce, these foods should not be neglected since they possess important chemicals that can help protect people from various diseases such as cardiovascular diseases, respiratory disorders, diabetes, and cancer [3]. *Allium cepa* and *Allium sativum* are rich in nutrients such as protein, carbohydrate, minerals, dietary fibre and vitamins. These vitamins are known to play a significant role in preventing tissue damage as a result of free radicals, hence they are recommended as good source of antioxidants. It was also reported that high levels of phytochemicals are recommended to prevent chronic diseases related to oxidative stress in the humans [4,5]. The present study, therefore, was aimed to analyse the antioxidant vitamins (A, C and E), phytochemicals (alkaloids, flavonoids, saponins, tannins, and glycosides), minerals (calcium, iron, manganese, copper and magnesium) and proximate compositions of *Allium cepa* and *Allium sativum* aqueous extract.

2. MATERIALS AND METHODS

2.1 Chemicals and Reagents

The reagents used for the study include concentrated H_2SO_4, petroleum ether, NaOH, Boric acid solution, Anhydrous Na_2SO_4, $CuSO_4$, distilled water, HCl, Wagner's reagent, Meyers reagent, Ferric chloride solution, Fehling's solution, Ethanol, Benzene, Ammonia solution, Methanol, Chloroform, Ethylacetate, Tannic acid, Folin-Denis reagent, Na_2CO_3, Lead acetate, Baljet reagent. All other chemicals and reagents used were of analytical grade and purchased from standard manufacturers.

2.2 Samples Collection

The two spices, *Allium sativum* (Garlic) and *Allium cepa* (Onions) were purchased from Sokoto market, Sokoto state Nigeria and were authenticated by a taxonomist at Botany Unit in Biological Science Department at the Usmanu Danfodiyo University Sokoto with identification numbers (UDUH/ANS/0088) for *Allium cepa* and (UDUH/ANS/0092) for *Allium sativum*. The spices were cleaned and then pounded into a wet paste using a mortar and pestle.

2.3 Extraction of Plant Samples

The procedure used was extraction by evaporation involving 5 g of the samples which

were pounded into a paste. The paste was inserted into 250 ml conical flask and 100 ml distilled water was added and covered with Aluminium foil. It was allowed to stand for 24 hours and filtered using Whatman No. 1 filter paper in a separate 250 ml conical flask. The filtrate was used for mineral and phytochemical analysis [6].

2.4 Digestion Procedure

2.0 g of the samples were weighed into Kjeldahl's flask mixed with 20 ml of concentrated H_2SO_4 and Helder tablet. The flask was then heated at 70^oC for 40 min and then, the heat was increased to 120^oC. The mixture was turned to black after a period of time. Digestion was completed after the solution became clear and white fumes appeared. The digest was diluted with 20ml of distilled water and boiled for 15 min. The solution was then allowed to cool, it was then transferred into 100ml volumetric flasks and diluted to the mark with distilled water. The sample solution was then filtered through a Whatman filter paper No. 1 into a screw-capped polyethylene bottle, the procedure was repeated for all samples.

2.5 Determination of Minerals

The method applied for the assessments of mineral concentration in samples after digestion was by using the Atomic Absorption Spectrophotometric (AAS) technique (Analyst 200, Perkin Elmer, Waltham, MA, USA) as described previously [7]. All tests were repeated 3 times, the mean and standard error of the mean was calculated (n = 3).

2.6 Determination of Antioxidant Vitamins

The method applied to the assessment of antioxidant vitamin(s) was using standard methods as described by Ruthkowski et al. [8] and Maciej and Krzysztof [9].

2.7 Phytochemicals Screening

2.7.1 Alkaloids

The presence of alkaloid in the samples was investigated using the methods described by Wagners [10]. The extract (0.5 g) was stirred with 5 ml of 10% aqueous hydrochloric acid in a steam bath for 20min. It was then cooled and filtered. 1ml of filtered was treated with a few drops of Wagner's reagent. Formation of brown precipitate indicates the presence of alkaloids in the extracts [10,11].

2.7.2 Tannins

The presence of tannins in the samples was determined using Ferric chloride test as reported by Okerulo [11] and Harbone [12]. 2 drops of 5% Ferric chloride solution was added to 1ml of the extract and the colour produced was noted. Condensed tannins indicated a dark greenish precipitate.

2.7.3 Test for saponin

The presence of saponin in the samples was analyzed using Harbone method [12]. Two grams (2 g) of the sample was placed in a beaker, 20 ml of water was then added and heated to boil for three minutes. The solution was allowed to cool and subjected to the following test.

2.7.4 Frothing with water

1 ml of the extract was placed in a test tube and shock thoroughly; the whole test tube was filled with froth that lasted for several minutes which indicated the presence of saponin [12].

2.7.5 Test for flavonoid

The determination of the presence of flavonoids in the sample was done using the methods described by Harbone [12]. 2 g of the sample was boiled in 20 ml of distilled water for 7- 10 minutes and filtered. The filtrate was acidified with 6-7 drops of dil. HCl and allowed to stand. 5ml of aliquots of the filtrate and 1ml of 10% NaOH was added, a yellow colour observed indicated the possible presence of flavonoids compounds.

2.7.6 Test for glycosides

10 ml of 50% H_2SO_4 was added to 1ml of the extract in a test tube. The mixture was then heated in boiling water for 15 minutes. A 10ml of Fehling's solution was added and the mixture was boiled. A brick red precipitate was observed, which indicate the presence of glycosides [12,13].

2.7.7 Test for cardiac glycosides

2 ml of 3.5% $FeCl_3$ was added to 1ml of the extract and allowed to stand for 1 minute. 1ml of conc. H_2SO_4 was then added carefully on the wall of the test tube so as not to interface with

the upper layer. Turning green to blue indicated the presence of 2- deoxy sugar containing cardiac glycosides [10].

2.7.8 Test for anthraquinone glycosides

5 g of the extract was boiled with 10 ml aqueous H_2SO_4 and filtered while hot. The filtrate was shaken with 5 ml of benzene, the layer was separated and 10% ammonia solution was added. Pink red or violet colour indicates the presence of anthraquinone glycosides [10].

2.7.9 Test for saponin glycosides

Saponin glycosides determination was done using methods described by Dalhat et al. [13]. To 2.5 ml of the sample, 2.5 ml of Fehling solution A and B was added. A bluish-green precipitate indicates the presence of saponin glycosides [6].

2.8 Proximate Analysis

2.8.1 Moisture content determination

An empty Petri-dish was cleaned and dried using an oven at 80^{o}C for about 30 minutes and was weighed (W_1). 2 g of the extract was placed in the Petri-dish and weighed (W_2), It was then placed in the hot air oven and dried at 65^{o}C for 24 hrs. Furthermore, It was cooled in a desiccator for 20 minutes and weighed (W_3). The procedure was repeated 3 times as follows: in the morning for about 5 hrs, cooled in a desiccator and weighed in the afternoon of which constant weight was ascertained [7].

Moisture content was calculated with the following expression:

$$\%Moisture = \frac{W2 - W3}{W2 - W1} X\ 100$$

Where

W_1 = weight of empty petri-dish
W_2 = weight of petri-dish plus dried sample
W_3 = weight of petri-dish plus sample after drying

2.8.2 Determination of total ash content

This procedure is based on the fact that when food material is in high temperature of 600°C for five hours, all the organic matter is burnt off leaving the inorganic substance in the form of ash [7]. A clean crucible was ignited in a hot furnace for one minute. The crucible was then removed and cooled in a desiccator and weighed (W_1). 2 g of the sample was placed in the empty crucible and weighed (W_2). The crucible containing the sample was then heated in a muffle furnace at 600°C for 5 hrs to burn off all the organic matter, after which the crucible was cooled in a desiccator and weighed (W_3) [7].

The percentage ash of a given sample was calculated using the formula in equation:

$$\%Ash = \frac{W3 - W1}{W2 - W1} X\ 100$$

Where

W_1 = weight of empty crucible
W_2 = weight of crucible plus dried sample
W_3 = weight of crucible plus sample after drying

2.8.3 Determination of crude protein

The procedure was carried out using Kjeldahl method as described by AOAC [7].

2.8.3.1 Crude protein digestion

1g of extract sample was weighed into a Kjeldahl flask. In addition, 5 g of anhydrous Na_2SO_4 was added to the Kjeldahl flask followed by addition of 1 g of $CuSO_4$ and 1 tablet of Kjeldahl catalyst. Into the mixture, 25 ml of conc H_2SO_4 and 5 glass beads were also added. The solution was heated gently and then increased with repeated shaking until a green colour was observed. The black particles seen at the neck of the flask was cooled and washed with distilled water. Reheating of the solution was done gently until the green colour disappeared and allowed to cool. After cooling, the digest was transferred with several washings into a 250 ml volumetric flask and filled to the mark with distilled water. Distillation was done using a distillation apparatus.

2.8.3.2 Protein distillation

The distillation apparatus was sterilized before use. 100 ml conical flask containing 5 ml of boric acid indicator was placed under the condenser such that its tip was under the liquid. 5 ml of the protein digest was pipetted into the apparatus via a small funnel aperture; the digest was washed down with distilled water followed by addition of 5 ml 60% NaOH solution. The mixture was steamed thoroughly for 7 minutes to collect enough $(NH_4)_2SO_4$. The condensed water and receiving flask were removed. Titration of the

solution was made in the receiving flask using 0.1 M H_2SO_4 and calculation of the nitrogen content using the formula below was done.

$$\%\ Nitrogen = \frac{TV\ X\ 0.014\ X\ \text{Dilution Factor (50ml)}}{\text{Weight of sample (g)}\ X\ ml\ of\ aliquot}\ X\ 100$$

%Crude protein = %Nitrogen X 6.25

Where

TV = Titre value
NA = Normality of acid

2.8.4 Determination of crude lipid

The non- polar components of the food sample are easily extracted into an organic solvent. n-Hexane is an organic solvent which dissolves easily. It has a low boiling point and highly volatile when treated at a low temperature (40-60^{o}C) in a flask fixed to Soxhlet apparatus using a reflux condenser. The vapour of the boiling n-hexane condenses and falls into the extracting chamber where the lipid contents are extracted and washed down to a flask [7]. The Soxhlet apparatus was set up and 2 g of the sample was placed into a thimble which has been dried and weighed. The thimble containing the powdered sample was weighed (W_1) and the mouth of the porous thimble was covered with cotton wool in order to distribute the dropping n-hexane. The thimble was then placed in the extraction chamber and n-hexane was added. The flask was then heated for 5- 6 hrs after which the flask was removed with care and the n-hexane at the top of the flask was evaporated. Finally, the extraction flask containing the oil weighed to know the content of the crude lipid [7].

The percentage ash of a given sample was calculated using the formula in equation:

$$\%Crude\ lipid = \frac{W3 - W1}{W2 - W1}\ X\ 100$$

Where

W_1 = weight of empty flask
W_2 = weight of sample
W_3 = weight of flask plus oil

2.8.5 Determination of crude fiber

The sequential hot digestion with the acid and alkaline solution of defatted sample is followed through washing with boiling water and finally drying off. This ensures the removal of all other material [7]. The sample (2 g) was placed in a conical flask and 20 mls of distilled water, 20 mls of 10% H_2SO_4 was added and then fixed to boil for 30 minutes to maintain a constant volume. The sample was filtered with a muslin cloth and rinsed with warm water. The sample was scrapped into a flask using a spatula. Then 20mls of 10% NaOH was added and placed on a heater again to boil for 30 minutes. The sample was filtered using muslin cloth and ethanol was used to rinse the sample once again, it was then allowed to drain and the residue was scrapped into a crucible. The crucible was then placed in an oven to dry at 65^{o}C for 1 hour after which the weight was taken (W_1). The crucible was then placed in a muffle furnace to ash for 2 hours at 550^{o}C and allowed to cool in desiccators and weighed again (W_2). Percentage fibre was then calculated using the equation.

$$\%Crude\ fiber = \frac{W2 - W3}{W2 - W1}\ X\ 100$$

Where

W_1 = weight of empty crucible
W_2 = weight of crucible plus sample
W_3 = weight of crucible plus sample after ashing

2.8.6 Determination of carbohydrate (by difference)

The carbohydrate content of a food sample is not determined directly but obtained by difference as shown in the equation [7].

% Carbohydrates = 100- (% moisture + % ash + % crude protein + % crude lipid + % crude fibre)

2.9 Statistical Analysis

Data were collected and subjected to statistical tests of significance using one-way ANOVA followed by Dunnett comparison test ($P < 0.05$) to assess results in the two spices. Results were presented in Mean ± Standard Error of mean ($n = 3$) and P value ($P < 0.05$) were considered as significant.

3. RESULTS AND DISCUSSION

The result of the proximate compositions of the spices; *Allium cepa and Allium sativum* showed significant difference ($P < 0.05$) (Table 1). *The* moisture contents of the spices were 86.67% in

Allium cepa, and 68.09% in *Allium sativum*. The values showed that the two spices were relatively wet (moisture contents higher than 12%) and would not be stored for a long period of time without microbial and biochemical spoilage. The moisture content of food can be used as an index of its keeping quality. Water is an important medium for most biochemical reactions, food samples with water content of >12% are more prone to high biochemical activities and usually have short shelf life [14].

Crude protein content was higher in *Allium sativum* compared to *Allium cepa*, thus, *Allium sativum* could serve as excellent sources of protein in the diet if consumed regularly in food. Protein is the building block and essential structural component of cells. It provides the body's required essential amino acids [14,15]. Protein content in food varies widely in food. The spices were also observed to have good source of fat. Fat content was lower (0.73%) in *Allium cepa* compared to (0.78%) in *Allium sativum*. High-fat content implies high calorific value and the possible presence of fat-soluble vitamins, namely vitamins A, D, E and K.

Spices are known to be rich sources of essential oils which account for their peculiar aromatic characteristics [15,16]. Crude Fiber was 0.58% in *Allium cepa* and 0.69% in *Allium sativum*. Dietary fibres are generally planted polysaccharides that cannot be digested by human digestive enzymes. Dietary fibres are either soluble or insoluble; both modulate physiological functioning and prevent some metabolic diseases in human. The fibre in the diet causes variations in the faecal water content, faecal bulk, transit time and elimination of bile acids and neutral sterols; which lowers the body's cholesterol pool. Fibres have been shown to reduce the incidence of coronary and breast cancer [16,17]. The *Allium sativum* spice showed higher ash contents (1.44%) compared to the *Allium cepa* spice. The Ash content refers to the inorganic residues remaining after either ignition or complete oxidation of organic matter in the sample and gives an overview of the mineral content of the material [13]. High ash content implies high mineral contents in the spices, *Allium sativum* is likely to be a better source of minerals in the diet as compared to the *Allium cepa* (Table 1). Nutritionally, ash aids in the metabolism of protein, carbohydrate and fat [18]. Carbohydrate content ranged from 9.89% to 20.46% in the spices. There was significant difference ($P < 0.05$) in carbohydrate contents of the spices. Carbohydrate provides energy to cells in the body, particularly the brain, the only carbohydrate-dependent organ in the body [17]. These spices could be supplementary for carbohydrate need in the diet. These spices are consumed in very small amount as food ingredients, and their contribution to nutrition in menu may not be as high as is the case with staple food items. However, among many rural consumers who use these spices copiously in various local dishes, the spices can make a meaningful nutritional contribution in menu.

Antioxidant vitamins concentration revealed a significant difference ($P<0.05$) when both spices were compared (Table 2), vitamin C content was higher in *Allium sativum* (4.30 mg/dl) than in *Allium cepa* (3.48 mg/dl). Vitamin contents of the spices were generally high when compared to vitamin contents of some commonly consumed spices, green leafy vegetables and fruits which are established dietary sources of vitamins [19]. For example, vitamin C content usually ranged from 43.5 to 148.0 mg / 100 g in green leafy vegetables and from 20 to 29 mg / 100 g in fruits [19].

The likely basis for high vitamin contents in these spices could be attributed to the raw utilisation of the spices. Sun drying had been reported to cause a marked decrease in vitamin contents of food materials. Also, it is evident from this study that of the two spices, *Allium cepa* had the least content of two of the vitamins (A and E), while *Allium cepa* had a higher content.

Table 1. Proximate analysis of *Allium cepa* and *Allium sativum* extract

Parameters	*Allium cepa* (%)	*Allium sativum* (%)
Moisture	86.67 ± 0.33^a	68.09 ± 1.49^b
Ash	0.67 ± 0.33^a	1.44 ± 0.01^b
Crude fibre	0.58 ± 0.01^a	0.69 ± 0.16^b
Crude lipid	0.73 ± 0.01^a	0.78 ± 0.01^b
Protein	1.46 ± 0.01^a	8.54 ± 0.66^b
Carbohydrate	8.60 ± 0.02^a	19.48 ± 1.43^b

Superscript a&b show statistically significant (P<0.05) in the comparison between the two groups

Table 2. Comparison of antioxidant vitamin concentration in *Allium cepa* and *Allium sativum* extract

Parameter	*Allium cepa* (mg/100 g)	*Allium sativum* (mg/100 g)
Vitamin A	669.63 ± 7.84[a]	482.96 ± 7.84[b]
Vitamin C	3.48 ± 0.05[a]	4.30 ± 0.03[b]
Vitamin E	277.12 ± 1.73[a]	143.14 ± 1.13[b]

Superscript a&b show statistically significant (P<0.05) in the comparison between the two groups

Table 3. Comparison of some mineral contents in *Allium cepa* and *Allium sativum* extract

Minerals	*Allium cepa* (mg/100 g)	*Allium sativum* (mg/100 g)
Manganese	0.012 ± 0.002	0.007 ± 0.005
Calcium	122.40 ± 0.459[a]	83.83 ± 0.571[b]
Copper	0.001 ± 0.0002	0.0005 ± 0.0002
Iron	0.026 ± 0.003	0.028 ± 0.002
Magnesium	3.15 ± 0.006	3.14 ± 0.006

Superscript a&b show statistically significant (P < 0.05) in the comparison between the two groups

Vitamins are generally needed daily in small amounts from foods. They yield no energy directly but may contribute to energy-yielding chemical reactions in the body and promote growth and development [20]. Vitamin C is mainly used for synthesising collagen, a major protein for building connective tissues. It is a general antioxidant, enhances iron absorption, and is needed for synthesising some hormones and neurotransmitters [21]. The spices had low contents of most of the minerals investigated in this study (Table 3 above). The most abundant mineral in the spices was calcium which ranged from 122.40 mg / 100 mg in *Allium sativum* to 83.83 mg / 100 g in *Allium cepa*. The spice *Allium sativum* was significantly ($P < 0.05$) higher source of calcium which also was comparatively a higher source than *Allium cepa. Allium sativum* had about twice (122.40 mg / 100 g) the amount of calcium content (83.83 mg / 100 g) in *Allium cepa*. Calcium is the most important and most common mineral needed in the body.

There was no significant difference ($P > 0.05$) in minerals between the two spices except in calcium. Calcium is needed for regulating most internal organs, including the heart and liver. It is needed for most physiological functional integrity, involving normal functioning of heart muscles, the skeletal system and cell membrane, blood clotting, nerve signal transmission and regulation of enzymes and hormones [21]. Deficiency of Ca in the body leads to malfunctioning of organ systems [21].

Next in the hierarchy of mineral contents in the spices was magnesium. *Allium sativum* had a higher amount of magnesium (3.15mg/100 g) compared to *Allium cepa* (3.14mg /100 g). Magnesium is needed for normal functioning of the body. It activates the enzymes necessary for carbohydrate metabolism [21,22].

The two spices are a good source of Iron. Iron is a major component of haemoglobin which transports the respiratory gases, namely oxygen (O_2) and carbon dioxide (CO_2) [23]. Deficiency of iron in the bloodstream may lead to death. Recommended dietary allowance (RDA) for iron is 15mg per day [21]. The two spices were also good source of manganese and copper. Minerals are known to play important metabolic and physiologic roles in living cells [24]. Minerals are divided into macro and micro minerals. The macro-minerals, calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) are required in large quantities. They are needed in diet in amounts of 100 mg or more per day while the micro-minerals iron (Fe), zinc (Zn), selenium (Se) and copper (Cu) are required in less than 100mg per day. Macro-mineral is required in more than 50 mg per kg of the body weight while less than 50 mg per kg of the body weight is required of micro-mineral. It is known that iron, selenium, zinc, magnesium and manganese strengthen the immune system as antioxidants [25]. Also magnesium, zinc and selenium are known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malfunctioning and bleeding disorder [26]. Minerals play important metabolic and physiological functions in living cells [24].

The result of the phytochemical screening showed that the extract of *Allium cepa* and *Allium* sativum contain, flavonoid, alkaloid, glycosides, saponin, tannin (Table 4). This is in agreement with the work done by Orengo et al. [27]. The phytochemical components present are known to possess both physiological and as well as medicinal activities. Tannins from *Allium cepa* skin have been reported to have antioxidant activity [28], and their presence supports the anti-inflammatory property of the vegetable and therefore may explain its use in the treatment of ulcer, earache and as antitussive. Alkaloids are very useful in medicine and are used in the production of several valuable drugs [29]. The presence of alkaloids indicates that this medicinal plant can be used as analgesic, antibacterial and antispasmodic. Saponins are glycosides of sterols and triterpenes and present in over seventy families of plants [30-33]. They have been reported to exhibit antitussive activity and also act as emulsifying agents [30].

Table 4. Comparison of qualitative phytochemicals in *Allium cepa* and *Allium sativum* extract

Parameters	*Allium cepa*	*Allium sativum*
Saponin	ND	+
Tannins	+	ND
Flavonoids	+	ND
Glycosides	ND	+++
Alkaloids	+++	++

Keys: +++ = High amount; ++ = Moderate; + = Low amount; ND= Not detected

4. CONCLUSION

Although the comparative assessment of the study showed *Allium cepa* has more medicinal benefit, both *Allium cepa* and *Allium sativum* are good sources of a wide diversity of antioxidant vitamins, phytochemicals and a rich source of minerals. This blend of nutrients may be responsible for their medicinal properties and therefore used in the prevention of many diseases. This work represents an endeavour towards establishing the pharmacological basis for the use of *Allium cepa* and *Allium sativum* in the management and prevention of many disease conditions.

5. RECOMMENDATIONS

Both *Allium cepa* and *Allium sativum* are good sources of nutrients and should not be neglected. It should always be included in the diets. Further research should be carried out on the molecular and pharmacological bases of the bioactive components and antinutritional factors of these spices in the treatment of diseases.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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