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Proximate Composition, Phytochemical Screening and Mineral Elements Profiles of Garlic (*Allium Sativum.*)

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Abstract

The purpose of this study was to assess the proximate composition, phytochemical and mineral element profile of garlic, providing insight into its possible culinary uses and health advantages. The results obtained for proximate analysis of Allium sativum (garlic) showed carbohydrates (62± 0.95%), crude fibre (1.66± 0.03%), ash (3.01 ± 0.14%), crude fat (6.05±0.78%), protein (15.37 ±1.71%) and moisture (10.62±0.69%). The results showed that Allium sativum has a high carbohydrate content and low value of moisture content indicating a longer shelf life. The phytochemical screening of Allium sativum showed the presence of alkaloid, flavonoid, phenolics, terpenoids, saponin, glycoside, steroids and the absence of tannin. The mineral elements analyses showed the presence of zinc (0.52mg/kg), phosphorus (9.01mg/kg), potassium (7.07mg/kg), calcium (20.23mg/kg) and magnesium (5.4mg/kg). This study revealed that Allium sativum contained nutrients that have the benefits of improving health conditions and ameliorating diseases.

Keywords: *Allium sativum (garlic), nutrients, proximate, phytochemicals, minerals.*

1. INTRODUCTION

A significant portion of traditional medical systems from antiquity have included natural products (Sarker *et al.*, 2023). As a natural source of chemotherapy and among scientists looking for alternative medication sources, they have come to play a very important role in modern civilization over time. One plant that has been used for centuries to treat infectious is *Allium sativum*, which has been the

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subject of extensive research over a number of years (Onyeagba *et al.,* 2015). It is a member of the *Amaryllidaceae* family. It is a crop that is cultivated globally. *Allium sativum* originated in Central Asia (Petropoulos *et al.,* 2018). Therapeutic usage of *Allium sativum* had a potential medicinal value for thousands of years against different microorganism's attack on humans. For example; antifungal, antiviral, antibacterial anti helminthic, antiseptic and anti-inflammatory properties of garlic are well documented (Petropoulos *et al.,* 2018) In Africa, particularly in Nigeria, it is used to treat abdominal discomfort, diarrhea, otitis media and respiratory tract infections (Jaber and Al-Mossawi, 2007). It was used to treat asthma, hay fever, and common colds in Europe and India (Clark, 2008). *Allium satium* is known to be nutritious, possesses antioxidant, antiviral, antibacterial, and antifungal properties. It has also been shown to have anti-cancer and anti-atherosclerotic qualities. Its efficiency and broad-spectrum antibacterial action against several species of bacteria, viruses, parasites, protozoa, and fungus have been shown in numerous studies (Jaber and Al-Mossawi, 2007). Gram-positive and Gram-negative bacteria, including *Enterobacter, Escherichia coli, Staphylococcus aureus*, and *Micrococcus,* are inhibited in growth by garlic extract. *Helicobacter pylori, Shigella, Lactobacillus, Pseudomonas, Proteus, and Klebsiella* (Tsao and Yin, 2001). This study's main objective is to assess the nutritional benefits and chemical composition of *Allium sativum* (garlic).

The use of *Allium sativum* as a medicinal plant has been documented since 1550 B.C., and massive conquests and nomadic traders allowed it to spread throughout the world (Etoh and Simon, 2002). The health-promoting properties of garlic are attributed to a particular chemical: *allicin* (Abayomi *et al.,* 2018). The chemical composition is greatly impacted by its variety, cultivation methods, and growth environment. Fertilisation practices and soil properties can have a major impact on quality attributes such as mineral composition, dry matter, protein content, and total soluble solids content (Ceryová and Cicová, 2021). The consequences on health of garlic are dependent on certain mineral levels, including zinc, selenium, potassium, and calcium (Vadalà *et al.,* 2016). The primary ingredients in garlic are potassium, phosphorus, magnesium, and calcium.

Garlic also contains a variety of chemical substances, including phospholipids, glycosides, adenosine, lectins, essential oils, and steroids (Nagella *et al.,* 2014).

Additional phytonutrients found in garlic have important health benefits; among these are, flavonoids, saponins and sapogenins, phenolic compounds, nitrogen oxides, amides, and proteins are given particular attention (Lanzotti. 2006). It is a condiment in both domestic and foreign cooking. It is utilised in nutritional supplements and drinks, such as croutons, garlic bread flavourings, and dough for pizza and rolls. It is also utilised in the creation of other culinary items like curry powder and garlic tea. Garlic can be added to different types of bread,

usually in butter or oil, to make a number of traditional foods, such as garlic bread, garlic toast, bruschetta, crostini, and canapé (Imafidon and Ukhun, 2019). The various cooking techniques alter the flavour's intensity and scent. It is typically mixed with ginger, tomato, or onion. The fully grown scapes are delicious and incredibly sensitive. They go by several names, including "garlic spears," "stems," and "tops." Cloves taste a little less pleasant than scapes. Similar to asparagus, they are frequently used for braising or stir-frying (Clark, 2008).

Many locations across the globe, Garlic leaves are a highly prized vegetable in many parts of the world. After being chopped and washed, the leaves are stir-fried with veggies, meat, or eggs. According to Gambbelli *et al*., (2021), garlic essential oil is one of the most potent natural antimicrobial agents that can be used in active antimicrobial packaging and food preservation. *Allium sativum* (garlic') s primary active ingredient, allicin, is mostly to blame for its ability to decrease blood pressure. Research has indicated that allicin inhibits the synthesis of angiotensin II, which raises blood pressure by constricting or tightening blood vessels (Benavides *et al.*, 2007). By preventing the production of angiotensin II, allicin's effects make it easier for the blood to flow freely, in turn, reducing blood pressure. Additionally, it appears that allicin increases the synthesis or availability of nitric oxide and hydrogen sulphide, two substances essential for controlling blood pressure levels (Al-Qattan *et al.,* 2006). Supplementing with garlic is known to improve immune system performance (Wallock *et al.,* 2014).

Studies have demonstrated that the allicin found in garlic have antibacterial qualities that may offer defence against bacteria, fungus, and viruses (Wallock *et al*., 2014). According to studies, eating garlic may help prevent cancer since it contains many bioactive compounds that either destroy or stop the growth of malignant cells (Mandal *et al.,* 2022).

2. MATERIALS AND METHOD

2.1. Sample Preparation

Fresh *Allium sativa* (garlic) bulbs were purchased from the Ibillo market in the Edo State local government area of Nigeria. The garlic was authenticated by Dr. H.A. Akinnibosun at the, Department of Plant Biology and Biotechnology, Faculty of Life Science, University of Benin, Benin City, Nigeria, with herbarium numbers of UBH-A388.

The (garlic) *Allium sativa* bulbs were cut into smaller pieces, cleaned with distilled water, and then allowed to air-dry for a period of two weeks. Using a mechanical blender, the dried sample was ground into a fine powdered and was kept in an airtight plastic container.

2.2 Determination of Moisture Content

Five grams (5g) of garlic powder were added to a dried, previously weighed crucible., which was kept in oven set at 105°C, this was left for three hours till steady weight, was obtained. The sample was weighed after cooling in a desiccator. The difference in weight was taken as the moisture content in percentage. This was done in triplicate (AOAC, 2014)

$$\%\ Moisture\ = \frac{weight\ of\ moisture}{weight\ of\ sample}\ \times 100.$$

2.3 Calculation of the Ash Content

The ash content was determined using muffle furnaces set at 560^{O}C. Five grams of garlic sample were measured into pre-weighed crucibles and kept in the muffle furnace for one hour, and then allowed to cool in a desiccator. The magnitude of ash and crucible were taken. The differences in weight was taken as the ash content express in percentage (AOAC, 2014)

$$\%\ Ash\ = \frac{weight\ of\ ash}{weight\ of\ sample}\ \times 100.$$

2.4 Determintion of Crude Fibre

A 500mL conical flask was filled with 5g of garlic powder. 200 millilitres of boiling 1.25% H_2SO_4 were poured into the conical flask that held the powdered garlic on a hot plate; it was allowed to slowly boil for thirty minutes while the volume was kept constant. Using a poplin cloth placed over a funnel on a conical flask, the solution was filtered. Hot distilled water was used to rinse the residue. Using a spatula, the residue was scraped back into the conical flask. The conical flask holding the residue was filled with 200 mL of boiling 1.25% NaOH, and it was gradually heated for 30 minutes while keeping a steady volume. After boiling, a poplin cloth was used to filter (AOAC, 2014).

$$\%\ Crude\ fibre\ = \frac{Oven\ wt\ of\ sample - Furnace\ wt\ \ of\ sample}{weight\ of\ sample}\ \times 100.$$

Crude fat was calculated by weighing 5 gramms of garlic sample. into a previously weighed filter paper and placed into a Soxhlet apparatus set at 68^{o}C containing hexane which served as the extraction solvent. The fat-containing flask was heated to 110°C in a hot air for 30 minutes The flask was heated and then allowed to cool in a desiccator. The weight of fat was measured after cooling (AOAC, 2014).

$$\%\ Crude\ fat\ = \frac{wt\ of\ fat}{weight\ of\ sample} \times 100.$$

2.5 Determination of Crude Protein

Garlic powder (1 gramme) and anti-bumping granules were weighed together in a Micro-Kjeldahl Digestion flask. Into each flask, two grammes of the catalyst mixture (CuSO4: Na_2SO_4: SeO_2, 5:1:02 w/w), were added, followed by the addition of ten millilitres of concentrated H_2SO_4. After shaking vigorously, 1 (one) millilitre of sodium potassium tartrate was added, and then 2.5 millilitres of sodium hypochlorite. After adding distilled water to get the solution up to the 25 mL mark, the absorbance of the finished product was measured using a UV/visible spectrophotometer.

The Nitrogen standards were treated the same way with the sample.

Where Abs= Absorbance, SR = Slope reciprocal, ER = Extraction ratio, CR = Colour ratio % crude protein percentage = N x 6.25

2.6 Determination of Nitrogen Free Extract (NFE) Determination

To compute this, add up all the other examined parameter values, then deduct 100 from the total. % NFE = 100 - (ash + crude fat + crude protein + moisture content + crude fibre).

2.7 Determination of Mineral Element

Ten millilitres of nitric acid and ten millilitres of perchloric acid were added in a ratio of one to three to a beaker containing one gramme of the sampled garlic. After the solution had been digested for approximately an hour in a fume cupboard, 10 millilitres of distilled water were added, agitated, and filtered into a 100 millilitre volumetric flask, with the filtrate being filled with distilled water to the 100millilitre mark Analysis of mineral elements was done using an atomic absorption spectrophotometer and a flame photometer on the sample.

2.8 Qualitative Phytochemical Screening

The phytochemical screening was conducted using the method outlined by Sofowora (2013).

Alkaloids test: 3 millilitres of garlic filtrate plus 2 millilitres of Dragendorff reagents yields a reddish-brown precipitate, which means the test was successful.

Test for phenols:1 millilitre of garlic extract was mixed with 5 millilitres of 90% ethanol. Next 1 drop of 10%$FeCl_3$ was added; a pale yellow-blue colour indicated a successful test.

To test for glycoside: 1 mL of garlic extract was dissolved in 1 ml of glacial acetic acid and a drop of ferric chloride solution, followed by a few drops of concentrated H_2SO_4. was added A brown ring was formed, which indicated that glycoside was present.

Test for Tannin: 2 millilitres of garlic extract was dissolved in 5 millilitres of distilled water, boiled for 3 minutes, and then strained into two halves. When ferric chloride ($FeCl_3$) was

added to 2 drops of filtrate, a bluish precipitate was forms, which signified a successful test.

Saponin test (Form test): 0.5g of garlic extract was added to 2mL of water was and shaken thoroughly, foaming was observed, which signified a successful test.

Test for Flavonoids: Two millilitres of garlic extract were boiled in ten millilitres of distilled water, and the resulting filtrate was separated into two sections (A and B). A positive test is indicated by the reddish precipitation that forms when a few drops of 10% lead acetate solution are added to A. A few drops of diluted HCl and 5 millilitres of a 20% NaOH solution were added to B. A colourless solution to the solution denotes a successful test.

Test for Terpenoids: 5 millilitres of garlic extract were combined with 2 millilitres of chloroform, and 3 millilitres of concentrated H_2SO_4 were carefully added. Reddish-brown colour indicated a positive test.

Test for Steroids: 0.5g of garlic extract in 2mL of diluted H_2SO_4 was mixed with 2ml of acetic anhydride. A positive test result Edina hue shift from violet to blue or green.

To test for eugenol: 2 millilitres of garlic extract was mixed with 5 millilitres of a 5% KOH solution. Then, it was separated and filtered the aqueous layer. A few drops of diluted HCl were added to the aqueous layer; a pale-yellow colour indicated a positive test (Sofowora, 2013)

3. RESULT AND DISCUSSION

Table 1: *Proximate Composition of Allium sativum* ***(Garlic)***

Nutrients	**Compositions (%)**
Moisture	10.62 ± 0.69
Ash content	3.01 ± 0.14
Crude fat	4.05 ± 0.78
Crude fibre	1.66 ± 0.032
Protein	15.37 ± 1.71
Carbohydrate	65.30 ± 0.95

Data are reported in mean standard deviations of triplicate determinations

Table 1 shows the results for proximate composition of garlic. Low moisture content generally is an indication of high shelf life especially for packaged foods against external condition. Garlic has a moderately low moisture content of 10.62% and fibre content of 1.66% which is the lowest, this however, disagreed with the work done by Abayomi *et al.,* 2018 were moisture content of garlic was (4.55%), crude fibre was (2.10%), crude protein (15,33%) and ash content (4.08%.) This differences might be attributed to different varieties of garlic, cultivation methods and the conditions under which the experiments were performed High fibre foods expands the inside wall of the colon, causing the smooth passage of waste, thus making it an effective anti-constipation (Imafidon and Ukhun, 2019). Fibre also helps in bowel movement and improves general health and well-being of individuals. The ash content and fat are moderately low of about (3.01%) and (6.05%) respectively. There is also about 15.37% Protein present which is an essential component of diet needed for the survival of both animal and human of which basic function is to supply adequate amount of energy required they are one of the building blocks of body tissue. It can also be inferred from the table that carbohydrate is highly present of about (63.30%) which suggest that garlic can be a potential source of energy for the body (Lanzotti, 2006).

Table 2: *Quantitative Screening for Phytochemicals Allium Sativum (Garlic)*

Phytochemical constituents	Observation
Glycosides	+++
Saponins	++
Phenols	+
Eugenols	+
Steroids	+
Alkaloids	+++
Flavonoids	++
Terpenoids	+
Tannins	-

+++ High concentration, ++ Moderate concentration, + Low concentration, - Absence

The results of this study suggested that several phytochemicals are present in Garlic (*Allium sativum*) extracts which are responsible for the plant's colour, flavour, smell and are also part of the plant`s natural defense system and protect them against herbivorous insects and vertebrates, fungi, pathogens, and parasite

The phytochemicals; glycoside, alkaloids saponin, flavonoid, steroid, phenols and terpenoid were present in garlic extracts according to this study and they are responsible for the therapeutic nature of garlic (*Allium sativum*).(Nagalla *et al.,* 2014

Table3: *Mineral Element Contents of Garlic (Allium sativum)*

Mineral	Concentration (mg/kg)
Zn	0.52±0.01
P	9.01±0.23
K	7.07±1.74
Ca	20.23±0.56
Mg	5.4±0.13

According to the result of this study, the mineral analysis of garlic extract contained essential mineral elements, of Zinc (0.52mg/kg), potassium (7.07mg/kg), magnesium (5.4mg/kg), phosphorous (9.01mg/kg) and calcium (20.23mg/kg). However, comparing this work with that conducted by Abayomi *et al.,* 2018, gave potassium (10.19mg/kg), calcium(26.30mg/kg), magnesium (10.19mg/kg), iron (5.29mg/kg and zinc(0,34mg/kg). this again can be attributed to differences in varieties, cultivation methods and growth environmental conditions The presence of these elements in garlic could be utilized as valuable nutrients for healthy living. For example, potassium, calcium and magnesium play a central role in the normal regulation of blood pressure. They are also valuable in improving immune system and preventing malnutrition related diseases. Mineral elements are required for normal growth, activities of muscles and skeletal development (such as calcium), magnesium helps chemical reaction in the body and intestinal absorption, potassium helps fluid balance and nerve transmission and phosphorus helps in the regulation of acid-base balance, zinc is useful for protein synthesis, normal body development and recovery from illness (Abayomi *et al.,* 2018)

4. CONCLUSION

Garlic is a remarkable food with both culinary and medicinal significance, and its proximate, phytochemicals and mineral contents make it a valuable nutrient in diets. The study had revealed that garlic is low in moisture, ash, fat and fibre contents, which help in ameliorating cardiovascular related health challenges and prostrate enlargements in males. Its high carbohydrate content makes it an excellent sources of dietary energy requirement. The essential minerals and phytochemicals contained therein, such as potassium, phosphorus, zinc,

magnesium and calcium, provide potential health benefits and antioxidants requirement for general populace.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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