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Research Article

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Preliminary Studies on Garlic (*Allium sativum* l.): Proximate Analysis and Mineral Composition

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Abstract Proximate analysis and mineral compositions of Garlic cultivated in Katsina state, Nigeria were determined using standard methods. The % moisture content obtained was (63.4 ± 1.05), % available carbohydrate (32.3 ± 1.06), % crude protein (14.0 ± 1.75), % crude fibre (9.0 ± 0.50), % ash (4.26 ± 0.20), % crude fat (3.8 ± 0.37). The energy value of the garlic is estimated to be 219.4 kcal per 100 g. Also the mineral content that was found on the garlic are; K (54.00 ± 1.40 mg/100 g), Ca (26.30 ± 0.14 mg/100 g), P (10.19 ± 0.26 mg/100 g), Fe (5.29 ± 0.08 mg/100 g), Na (4.10 ± 0.14 mg/100 g), Mg (3.97 ± 0.17 mg/100 g), Zn (0.34 ± 0.17 mg/100 g), Mg (0.016 ± 0.00 mg/100 g), Cu (0.012 ± 0.00 mg/100 g) with few exceptions. The results recorded shows a very good agreement with literature values and also provide information on the nutritional value of Garlic sold in Katsina market, Nigeria.

Keywords Proximate, garlic, moisture, protein, carbohydrate

Introduction

Spices and herbs have played a very important role in the development of Western civilization. Spices today are plentiful and are used mostly as flavorings. However, in ancient and medieval times, they were rare and precious products, used for medicine, perfume, incense, and flavoring [1]. Brester defines spice as a dried seed, fruit, root, bark, leaf, or vegetative substance used in nutritionally insignificant quantities as a food additive for the purpose of flavor, color, or as a preservative that kills harmful bacteria or prevents their growth [1].

Bulb species; Bulb as an underground storage organ, comprising of a short, flattened stem with roots on its lower surface, and above it fleshy leaves or leaf bases, surrounded by protective scale leaves [2]. It may provide the means for vegetative reproduction, or for the survival of the plant from one season to the next.

Therefore, bulbs such as garlic and is considered to be one of the major types of spices used by man day in and day out throughout recorded history, mostly for medicinal and culinary purpose [3]. The health benefits of Allium species especially garlic (*Allium sativum* L.) have been known for thousands of years, but recently interest in other bulb species has been increasing, this is because *Allium* species have been found to prevent tumor promotion, cardiovascular diseases and aging [4,5]

In Nigeria, particularly in Hausa land, it is refers to as "*Tafarnuwa".* The photograph is shown in figure 1.

Figure 1: The photograph of garlic (Allium sativum L.)

Study Area

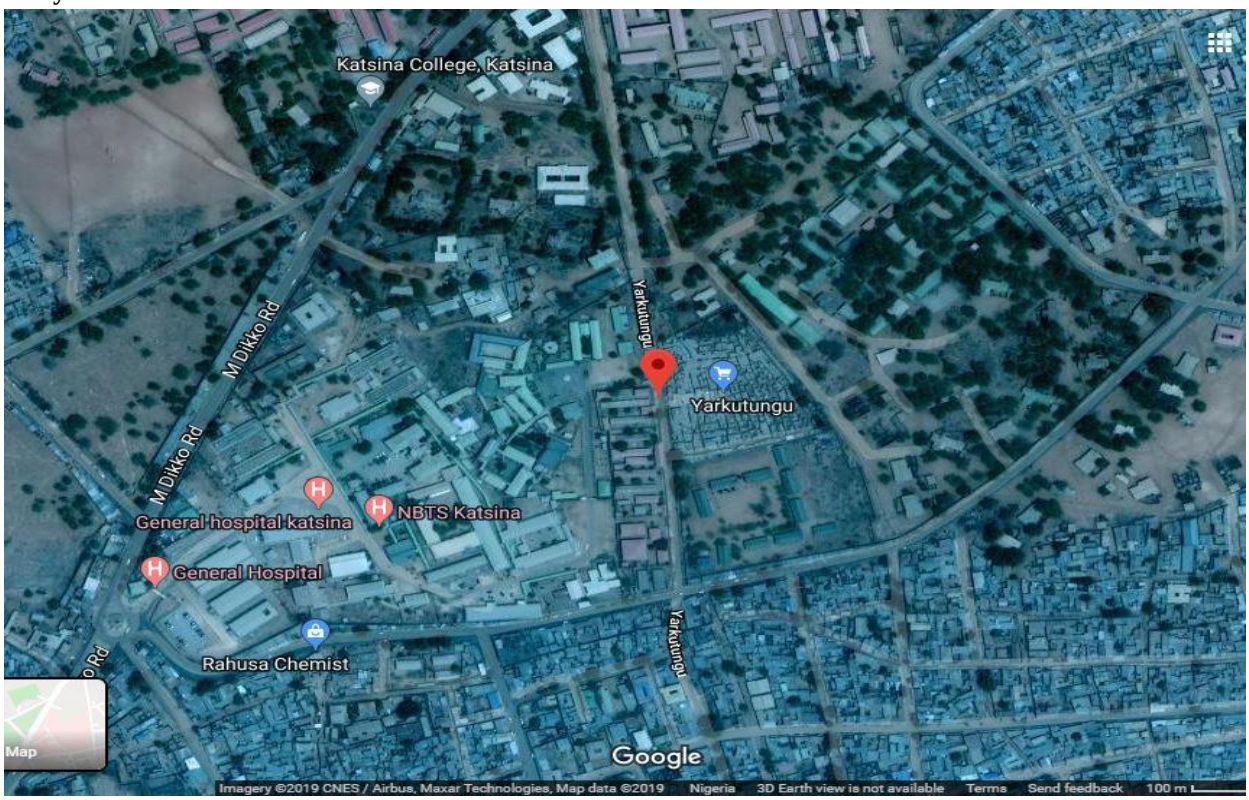

Figure 2: Map showing the study location (source: www.google.com/maps/)

Materials and Method

Wet digestion of sample

The 1.0 g of the powdered sample was taken in digestion glass tube. 12 cm^3 of HNO_3 was added to the sample and kept for overnight at room temperature. Then 4.0 cm^3 of $HClO_4$ was added to this mixture and was kept in the fumes block for digestion. The temperature was increased gradually, starting from 50^0C and increasing up to 250^o-300^oC. The digestion completed in about 70-85 minutes as indicated by the appearance of white fumes. The mixture was left to cool down and the contents of the tubes were transferred to 100 cm^3 volumetric flasks and the volumes of the contents were made to 100 cm^3 with distilled water. A blank solution was prepared using the same method but with 50 cm^3 distilled water instead of the sample. Wet digested solution was transferred to plastic bottles labeled accurately. Stored the digest and used it for mineral determination using atomic absorption spectroscopy [7,11]

Sampling

Fresh bulbs of garlic (*Allium sativum* L.) were obtained from "Yarkutungu" market Katsina from which representative samples were taken and samples were transported to the laboratory in an air tight polythene bag and identified at the department of biological science, Umaru Musa Yar'adua University Katsina.

Method of Analysis

Sample Treatment

The bulbs of garlic (*Allium sativum* L.) were washed with distilled water, dried and the flesh was manually removed using sharp laboratory knife leaving the shell then cut into uniform sizes and a small part was taken for moisture determination and the rest were room dried, pulverized using mortar and pestle to a fine powder and stored in a plastic container for analysis.

Proximate Analysis

Proximate analysis of garlic (*Allium sativum* L.) was carried out using the method of AOAC [6] which involves the determination of ash content, moisture content, protein content, crude fibre, crude lipid and carbohydrate content.

Determination of %Moisture

An empty crucible was weighed (w_0) and 5 g of the raw (wet) sample was transferred into the crucible and weighed (w_1). The content of the crucible was dried in a hot air drying oven at 105-110^{o}C for 24 hours, cooled and weighed (w_0). Drying, cooling and weighing were repeated till a constant weight was obtained [7]. The moisture content was calculated using the equation below:

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight } \times\ 100}{\text{Sample weight}}$$

Determination of % Ash content

5 g of the dried sample was transferred into an empty crucible and weighed. The crucible content was ashed (500-600^{o}c for 3 hours) in a muffle furnace, cooled and weighed [7]. Percentage ash content was calculated using the equation below:

$$\text{Ash (\%)} = \frac{\text{Weight of ash } \times\ 100}{\text{Sample weight}}$$

Determination of % Crude Fat

5 g of sample was wrapped in a porous paper (Whiteman filter) and put in a thimble. The thimble was put in a soxhlet reflux flask and mounted in a weighted extraction flask containing 200 ml of petroleum ether. The upper of the reflux flask was connected to a water condenser.

The solvent (petroleum ether) was heated boiled, vaporized and condensed into the reflux flask filled. Soon the sample in the thimble was covered with the solvent until the reflux flask filled up and siphoned over, carrying its oil extract down to the boiling flask. This processed was allowed to go on repeatedly for 4hr before the defatted sample was removed, the solvent recovered and the oil extract were left in the flask. The flask (containing the oil extract) was dried in the oven at 60 ºC for 30 min to remove any residual solvent. It was cooled in desiccators and weighted [8]. The weight of oil (fat) extract was determined by difference and calculated as a percentage of the weight of sample analyzed thus;

$$\text{Fat (\%)} = \frac{\text{w2} - \text{w1} \times 100}{\text{weight of sample}}$$

Where: *W1 = weight (g) of empty crucible; W2 = weight of crucible + ash*

Determination of % Crude Protein

This was done by kjeldahl method. The total nitrogen was determined and multiplied with factor 6.25 to obtain protein content. Sample (5 g) was mixed with 10 ml of concentrated H_2SO_4 in digestion flask. A tablet of selenium catalyst was added to it before it was heated under a fume cup board until a clear solution was obtained (the digest). The digest was diluted to 100ml in a volumetric flask and used for the analysis. The 10 ml of the digest was mixed with equal volume of 45% NaOH solution in a kjeldahl distillation apparatus. The mixture was distilled into 10ml of 40% boric acid containing 3 drops of mixed indicator (bromocressol green /methyl red). A total of 50 ml of distillates was collected and titrated against 0.02 N EDTA from green to a deep red end point. A reagent blank was also digested, distilled and titrated [3]. The nitrogen content and hence the protein content was calculated using the formula below:

1 ml of 1 N H_2SO_4 = 14 mg

Protein (%) = N_2 (%) × 6.25

$$N_2\ (\%) = \frac{100 \times N \times 14 \times Vt \times T.B}{W \times 1000 \times Va}$$

Where:

W = Weight of sample (5 g)

N = Normality of titrant (0.02 N H_2SO_4)

Vt = Total digest volume (100 ml)

Va = Volume of digest analyzed (10 ml)

T = Sample titre value

B = Blank titre value

Determination of % Crude Fibre

Sample (5.0 g) processed sample was boiled in 150 ml of 1.25% H_2SO_4 solution for 30 min under reflux. The boiled sample was washed in several portions of hot water using a two-fold cloth to trap the particles. It was returned to the flask and boiled again in 150ml of 1.25% NaOH for another 30 min under same condition. After washing in several portion of hot water the sample was allowed to drain dry before being transferred qualitatively to a weighted crucible where it was dry in the oven at 105ºC to constant weight. It was therefore taken to a muffle furnace where it was burnt, only ash was left of it [9]. The weight of the fibre was determined by difference and calculated as a percentage of the weight of sample analyzed thus:

$$\text{Crude fibre (\%)} = \frac{W_2 - W_3\ X\ 100}{\text{Weight of sample}}$$

Where:

W_2 = Weight of crucible + sample after washing, boiling and drying

W_3 = Weight of crucible + sample ash.

Available Carbohydrate

Available carbohydrate was calculated by subtracting the total of the percentages of ash, crude protein, crude lipid and fibre from 100% moisture free sample [7].

Minerals Determination

Minerals content was determined by atomic absorption spectrometry according to the methods of AOAC [6]

Results and Discussion

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

Parameter	Quantity (%)
Moisture	63.4 ± 1.05
Ash	4.26 ± 0.20
crude protein	14.0 ± 1.75
Crude Fibre	9.0 ± 0.50
Crude Fat	3.8 ± 0.37
Avail. Carbohydrate	32.3 ± 1.06

Table 2: Minerals composition of Garlic (*Allium sativum L.*)

Minerals	Concentration (mg/100 g)
Potassium	54.00 ± 1.40
Calcium	26.30 ± 0.14
Phosphorus	10.19 ± 0.26
Iron	5.29 ± 0.08
Sodium	4.10 ± 0.14
Magnesium	3.97 ± 0.13
Zinc	0.34 ± 0.17
Manganese	0.016 ± 0.00
Copper	0.012 ± 0.00

From table 1 above, the result was obtained and taken into record, which the content of moisture, ash, crude protein, crude fibre, crude fat and available carbohydrate are (63.4 ± 1.05, 4.26 ± 0.20, 14.0 ± 1.75, 9.0 ± 0.50, 3.8 ± 0.37, 32.3 ±1.06) % respectively. The data were determined in triplicate and the data are expressed in mean ± standard deviation. The results shows that garlic has high moisture content (63.4 %) followed by carbohydrate content which is 32.3% and it was low in ash content (4.26 %) and crude fat content (3.8 %). According to the data present in Table 2, the mineral profile of garlic showed that it contains potassium as a major mineral in a maximum quantity (54.00 ± 1.40 mg/100 g), followed by calcium (26.30 ±0.14 mg/100 g), phosphorus (10.19 ± 0.26 mg/100 g), iron (5.29 ± 0.08 mg/100 g), sodium (4.10 ± 0.14 mg/100 g) and magnesium (3.97 ± 0.13 mg/100 g) respectively. Furthermore, other minerals like zinc (0.34 ± 0.17 mg/100 g), manganese (0.016 ± 0.00 mg/100 g) and copper (0.012 ± 0.00 mg/100 g) are presented in a lowest quantities.

Conclusion

It has been found that garlic may produce modest but not clinically significant effects in the treatment of dyslipidemia and hypertension. Traditionally, it has been used for it antiseptic and antibacterial properties, as well as for treating the common cold, upper respiratory tract infections, mild bronchitis, and rhinitis, and to relieve cough and congestion.

Base on the results determined on the proximate analysis of garlic it's hereby shows content with % moisture content (63.4 ± 1.05), % available carbohydrate (32.3 ± 1.06), % crude protein (14.0 ± 1.75), % crude fibre (9.0 ± 0.50), % ash (4.26 ± 0.20), % crude fat (3.8 ± 0.37). The energy value of the garlic is estimated to be 219.4 kcal per 100 g. Also the mineral content that was found on the garlic are; K (54.00 ± 1.40 mg/100 g), Ca (26.30 ± 0.14 mg/100 g), P (10.19 ± 0.26 mg/100 g), Fe (5.29 ± 0.08 mg/100 g), Na (4.10 ± 0.14mg/100 g), Mg (3.97 ± 0.17 mg/100 g), Zn (0.34 ± 0.17 mg/100 g), Mg (0.016 ± 0.00 mg/100 g), Cu (0.012 ± 0.00 mg/100 g).

In conclusion, Garlic has a positive nutritional impact in the life of living organisms as well as human health if properly consumed. Although, many and more research should be carry out on garlic in order to enhance and to have a profitable consumption.

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