Chemical and mineral analysis of garlic: a golden herb

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ABSTRACT

Garlic is commonly used as flavoring, culinary and herbal remedies. It is an essential vegetable throughout the world not only as a spice but also a traditional medicine. In the present research garlic as a raw material was explored to its chemical composition as well as its mineral analysis. The current study proved that it contains 64.58± 2.06% moisture, 7.87±0.32 protein, 0.52±0.01 ether extract, 2.3±0.08 fiber, 2.46±0.09 ash and 22.27±0.95% NFE, whilst, the mineral analysis suggested its composition as calcium, phosphorous, iron, sodium and magnesium as 54.65±1.74, 19.83±0.83, 9.54±0.34, 4.21±0.15, 4.1±0.18 and 3.97±0.13 mg/100 g however, zinc, manganese and copper were in traces.

Keywords: Garlic, Medicinal Herb, Chemical composition, Moisture, Protein, Mineral Assay

INTRODUCTION

Garlic (Allium sativum) belongs to the family Alliaceae is one of the 600 known species including onion, shallots and leek (Rehman, 2003). It is broadly classified into two varieties hard neck (ophioscordon) and soft neck (sativum) (Borek, 2001). It has also been used in medical science and culinary purposes since ancient times. The oldest-known cultivated plants as an integral component of human diet. Egyptian fed garlic to pyramid crews to boost their immunity thereby rendering safe from various maladies and improve their performance (Rivlin, 2001).

The nutritional composition of garlic revealed that it contains approximately 65, 28, 2.3, 2.0, 1.2 and 1.5% water, carbohydrates, organosulfur compounds, protein, free amino acids and fiber respectively (Odebunni et al., 2009). The consumption of 100 g of garlic provides 149 kcal. It contains approximate amount of potassium (21 g/kg) phosphorous (6 g/kg) followed by magnesium (1 g/kg) sodium (532.78 mg/kg) calcium (363.61 mg/kg) and iron (52.91 mg/kg). In addition, selenium and germanium are also present in garlic and their amount depends upon contents of minerals present in the soil (Haciseferogullari et al., 2005). Garlic also contains vitamins especially thiamin with high bioavailability owing to some specific sulfur containing components (Kik et al., 2001).

The moisture content of garlic was determined by AACC (2000) Method No. 934-01 accordingly. 10 g sample was dried in hot air oven (Model: DO-1-30/02, PCSIR, Pakistan) at a temperature of 105± 5 °C for the duration until weight was constant.

Moisture Content

Garlic samples were evaluated for moisture, crude protein crude fat, crude fiber, ash and nitrogen free extract (NFE) according to their respective methods as mentioned in AACC (2000). All the tests were carried out in triplicates. Principle of each method is briefly described as follow:
sample is assessed by titrating distillate against 0.1N H$_2$SO$_4$ solution till color is light golden. Crude protein content was estimated by multiplying nitrogen percent (N %) with factor (6.25).

\[
N (\%) = \frac{\text{Vol. of 0.1N } H_2SO_4 \times 0.0014 \times \text{Vol. of dilution}}{(250ml) \times X 100}
\]

\[
\text{Crude protein (\%) = Nitrogen (\%) X 6.25}
\]

**Crude Fat**

The crude fat content in garlic sample was estimated following guidelines of Method No. 920-39 in AACC (2000). Dried sample (3 g) was refluxed in soxhlet apparatus (Model: H-2 1045 Extraction Unit, Hoganas, Sweden) using n-hexane as a solvent.

**Crude fiber**

The garlic sample was subjected to crude fiber content by elaborating Method No. 978-10 outlined in AACC (2000). Fat free sample was digested with 1.25% H$_2$SO$_4$ followed by 1.25% NaOH solution in Labconco Fibertech apparatus (Labconco Corporation Kansas, USA). After filtration and washing with distilled water reaming residues was weighed and ignited in muffle furnace at temperature of 550-650°C till grey or white ash was obtained. The crude fiber percentage was estimated according to the expression given below.

\[
\text{Crude fiber} = \frac{\text{weight loss on ignition (g) X 100}}{\text{weight of sample (g)}}
\]

**RESULTS AND DISCUSSION**

**Proximate and mineral analysis**

Chemical composition of garlic was analyzed along with other parameters and findings are presented in Table 1. Results showed that garlic contained moisture contents 64.58±2.06, crude protein 7.87±0.32, crude fat 0.52±0.01, crude fiber 2.3±0.08, ash 2.46±0.09 and NFE 22.27±0.95%, whereas dry matter in garlic sample was calculated to be 35.42±1.09%.

Results are comparable with the earlier findings of Otunola et al. (2010). They showed that moisture, crude protein, crude fat, total carbohydrates, fiber and ash contents in garlic sample were 4.55±0.1, 15.33±0.0, 0.72±0.0, 73.22±0.0, 2.10±0.0, 4.08±0.10% respectively on dry basis. Previous findings by Nwinuka et al. (2005) revealed that garlic contains moisture, crude protein, crude fat, total carbohydrates and ash contents i.e. 4.88±0.13, 17.35±0.00, 0.68±0.0, 73.03±0.06 and 4.06±0.10% correspondingly on dry weight basis. They also mentioned that 100 g of garlic sample provides about 367.64 Kcal. The results of proximate analysis of garlic powder are comparable to the research conducted at

**Total ash**

The ash content of peel was estimated according to the procedure mentioned in AACC (2000) Method No. 942-05. For which, 5 g sample was directly charred on flame in crucible until there was no fumes coming out. Afterwards sample was ignited in muffle furnace (MF-1/02, PCSIR, Pakistan) at 550-600°C for 5-6 hours or until grayish white residues were obtained.

**Nitrogen free extracts (NFE)**

The nitrogen free extract (NFE) of citrus peel was calculated according to the following equation:

\[
\text{NFE} = 100 - (\% \text{ moisture} + \% \text{ ash} + \% \text{ crude fat} + \% \text{ crude fiber} + \% \text{ crude protein})
\]

**Mineral contents**

Garlic was analyzed for its minerals following AOAC (2006). Sample (0.5g) was digested by using HNO$_3$ and perchloric acid at ratio of 7:3 on hot plate until solution turned colourless and remained 1-2 mL. Digested sample was diluted up to 100 mL for mineral analysis. Sodium, potassium and calcium were calculated on Flame Photometer-410 (Sherwood Scientific Ltd., Cambridge) on the other hand, copper, iron, magnesium, manganese, phosphorus and zinc were determined through Atomic Absorption Spectrophotometer (Varian AA240, Australia).

Research 900 Laboratory mentioned in Encyclopedia of Chemical Technology (1980) they recorded moisture 5.4%, protein 17.5%, lipid 0.6% and total carbohydrate 73.3%.

Another group of researchers Odebunmi et al. (2009) evaluated the chemical composition of garlic and concluded that it contains moisture 66.57±1.58%, protein 7.87±0.76%, fat 0.52±0.09%, crude fiber 0.73±0.19%, ash contents 1.33±0.04% and dry matter 33.43±1.58%. According to the present data, mineral profile of garlic (Table 2) showed that it contains potassium as a major mineral in a maximum quantity (54.65±1.74 mg/100g) followed by calcium (19.83±0.83 mg/100g) phosphorous (9.54±0.34 mg/100g) iron (4.21±0.15 mg/100g) sodium (4.1±0.18 mg/100g) and magnesium (3.97±0.13 mg/100g) respectively. Furthermore, other minerals like zinc, manganese and copper were present in lowest quantities 0.34±0.01, 0.016±0.00 and 0.012±0.00 mg/100g, respectively.

Extensive research has been carried out to estimate the amount of mineral elements present in garlic. The results obtained from the previous findings of Otunola et
al. (2010) reported that potassium (54.00±1.40 mg/100g) being the most abundant element in garlic followed by calcium (26.30±0.14 mg/100g) phosphorous (10.19±0.26 mg/100g) iron (5.29±0.08 mg/100g) sodium (4.10±0.14 mg/100g) and magnesium (4.10±0.14 mg/100g) in considerable amount, while zinc, copper and manganese were in lowest quantity (0.34 ± 0.17 mg/100g) (0.001 ± 0.00 mg/100g) and (0.001 ± 0.00 mg/100g) respectively.

According to the findings of Sampath et al. (2010) garlic composition contained approximately water 84.09, inorganic matter 1.53 and organic matter 13.38% while garlic leaves contained water 87.14, inorganic matter 1.59 and organic matter1.27%. Afterwards, Ujowundu et al. (2011) studied that garlic possess minerals like Cu (0.373 mg/100g), Fe (3.48 mg/100g), Ca (1.904 mg/100g), Se (0.02 mg/100g), and Mg (4.334 mg/100g), while zinc was not detected.

**REFERENCES:**