Research Article

Comparison of Proximate Composition and Mineral Concentration of *Allium ampeloprasum* (elephant garlic) and *Allium sativum* (garlic)

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Abstract

Allium sativum (garlic) is a commonly used and widely cultivated spice within the country as well as throughout the world. Besides using as food and spice, their therapeutic properties were highly valued. While *Allium ampeloprasum* (elephant garlic), a wild *Allium* species which is lesser cultivated and its nutrient composition are scarcely known. So, the aim of this study was to compare proximate composition, mineral concentration and heavy metals content of *Allium ampeloprasum* and *Allium sativum*. The results revealed that the proximate composition between the two *Allium* species showed significant differences, crude protein content was significantly higher in *A. ampeloprasum* (6.21 percent) whereas ash content and crude fiber was higher in *Allium sativum* i.e., 1.66 and 2.70 percent, respectively. *A. sativum* showed slightly higher mineral content than *A. ampeloprasum*; potassium showed maximum mineral content followed by sulfur in both the *Allium* species. Rich source of calcium, phosphorus, magnesium and iron content was found in both the *Allium* species. Heavy metal like arsenic, nickel and lead showed maximum concentration in *A. sativum* in comparison with *A. ampeloprasum*. The study concluded that *A. ampeloprasum* has a good source of nutritional values and trace mineral which can be comparable with garlic. Thus, this nonconventional wild bulb should be commercialized to increase the variety of vegetables consumed and considered as a good alternative to enhance the quality of diets.

Keywords: *Allium sativum; Allium ampeloprasum*; proximate composition; heavy metals

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Introduction

Allium is the largest and the most important representative genus of the *Alliaceae* family which consists of nearly 700 species, widely distributed all over in Europe, North America, Northern Africa and Asia [1]. Most *Allium* members have a distinctive variation in color, taste, and flavor but closely related to biochemical and photochemical properties [2]. *Allium sativum* (garlic) is commonly used in many cultures as a seasoning or spice and highly regarded throughout the world for its medicinal and culinary value. It also considered one of the most utilized supplements. Due to its sulfur-containing compounds, high trace mineral content and enzymes, garlic has shown anti-viral, antibacterial, anti-fungal and antioxidant abilities [3]. Extensive studies have shown that garlic possesses a wide range of bioactive effects, including antimicrobial, anticancer, antihypertensive, hepatoprotective, and insecticidal properties [4]. *Allium ampeloprasum* is a medicinal plant well known for its pharmaceutical potential. It is commonly known as elephant garlic or wild leek (broadleaf) belongs to the *Alliaceae* family which is native to the Mediterranean region such as South Europe, Northern Africa to Western Asia [5]. It is a monocot bulbous perennial plant [6]. Commercially, elephant garlic is used interchangeably with garlic; however, it is morphologically different from garlic and has a less intense odor and milder flavor [7]. Elephant garlic is highly prized for its medicinal property and believed that its medicinal value is much greater than the commonly used garlic (*Allium sativum*) [8]. Few studies have been performed on the composition and nutritional properties of *Allium ampeloprasum*.

Materials and Methods

Collection of materials: *Allium ampeloprasum* (elephant garlic) and *Allium sativum* (garlic) were procured from the department of vegetable science, Punjab Agricultural University, Ludhiana.

Preparation of the samples: About 100g of *Allium ampeloprasum* and *Allium sativum* were peeled, washed and cleaned. The cloves were cut into small pieces and spread over butter paper lined over tray. The samples were dried to a constant weight at 50° C for 8-10 hours. Dried samples were grinded into fine powder and packed in airtight plastic pouches. The samples were stored in deep freezer at -18° C for further analysis.

Proximate analysis: Proximate composition was determined according to Association of Official Analytical Chemists (AOAC) [9]. *Allium* samples (fresh weight) was weighed in the china crucible and dried in a hot air oven for 8 hours at 105º C. The loss in weight represented the moisture content of the sample. The ash content was determined by placing the samples in a muffle furnace at 550º C for 4 hrs. The residue left in the crucible was weighed. Crude protein was determined by the macro-Kjeldahl method as total nitrogen and a factor of 6.25 for conversion of nitrogen into protein was applied. The crude fat was determined using Soxhlet method by SOCS PLUS automatic solvent extraction system (Pelican India limited). Crude fiber was estimated by digestion with sulphuric acid and sodium hydroxide in FIBRA PLUS automatic fiber estimation system (Pelican India limited).

Mineral analysis: The dried samples were wet digested with diacid mixture consisting of nitric acid and perchloric acid in the ratio 5:1, respectively. Elements were estimated using atomic absorption spectrophotometer (AAS, Varian model) after wet digestion [10].

Statistical analysis: All the analysis work was conducted in triplicate. Mean and standard deviation was computed in all the parameters. The data obtained were subjected to Student's t-test to detect significant differences ($p<0.05$) among the samples using IBM SPSS 23.

Results and Discussion

Proximate composition: *The proximate composition of Allium ampeloprasum and Allium sativum are presented in table 1.*

Moisture

The moisture content of *A. ampeloprasum* and *A. sativum* was 52.37±0.41 and 53.77±0.54 percent, respectively. The statistical analysis showed no significant difference between them. The moisture content in *A. ampeloprasum* reported by Garcia-Herrera *et al* [12] showed higher mean value ranged from 76.02 to 81.50 percent as compared to the present data.

The moisture content in *A. sativum* reported by Tesfaye and Mengesha [11] was 58 percent, different authors gave a wide range of moisture content in *A. sativum* i.e., 64.58 percent [13], 62.19 percent [14] and 59.81 to 66.22 percent for different garlic cultivars [15].

Crude protein

Crude protein content was higher in *A. ampeloprasum* with 6.21±0.15 percent as compared to 4.85±0.07 percent in *A. sativum* and high significant differences ($p<0.01$) in protein value was showed. The crude protein content in *Allium sativum* is at par with the value reported by Tesfaye and Mengesha [11] i.e., 6.39 g/100g. Protein content was vary depends on the methods of drying, a study conducted by Sangwan *et al* [16] displayed the crude protein in *A. sativum* in different methods of drying ranges 7.87 to 8.73 percent. Dey and Khaled [8] and Garcia-Herrera *et al* [12] reported lower protein content in *A. ampeloprasum*, the values were 1.9 g/100g and 1.67 percent, respectively.

Ash content

The ash content of *A. ampeloprasum* and *A. sativum* were significantly different ($p<0.01$) i.e., 1.39±0.04 and 1.66±0.01 percent, respectively. Ash content in *Allium sativum* reported by Khalid *et al* [14] found to be comparable to the present study i.e.1.48 percent, 2.46 percent was reported by Sajid *et al* [13] and Gulfraz *et al* [17] reported 0.81 to 0.9 percent.

Crude fat

The fat content of *Allium ampeloprasum* and *Allium Sativum* was 0.53±0.03 and 0.66±0.05 percent, respectively. No significant difference was found between two. Dey and Khaled [8] and Garcia-Herrera *et al* [12] reported 0.4 and 0.18 percent of the fat content in *A. ampeloprasum*, respectively. Sangwan *et al* [16] reported higher value of fat in *A. Sativum* as compared to the present findings, the value ranged from 0.78 to 0.92 percent. Sajid *et al* [13] reported 0.52 percent, 0.72 percent [18], 0.68 percent by Nwinuka *et al* [19] and 0.48 percent [14] in *A. sativum*. The differences may be due to the varietal difference, growing or harvesting season, agricultural practices etc.

Crude fiber

The crude fiber content in *A. sativum* was 2.70±0.08 percent and showed significantly ($p<0.01$) higher than *A. Ampeloprasum* i.e., 1.24±0.22 percent. The fiber value of *A. ampeloprasum* reported by Garcia-Herrera *et al* [12]

showed a higher value than the present findings, it ranged from 3.56 to 4.72 percent for different cultivars. The results of *A. sativum* reported in the present data are comparable with the previous studies, 2.05 percent [14], 2.3 percent [13], 2.10 percent [18] and 2.1 percent [11]. Higher crude fiber value was reported by Sangwan *et al* [16] in different methods of drying i.e., 4.78, 4.49, 4.62 and 4.86 percent (shade dried, solar dried, oven dried and microwave dried, respectively). On the contrary, a study performed by Odebunmi *et al* [20] showed the lower mean value of crude fiber in *A. sativum* i.e., 0.73 percent as compared with the present study.

Table 1 Proximate composition of *Allium ampeloprasum* and *Allium sativum* (Dry weight basis)

Proximate composition (percent)	*Allium ampeloprasum*	*Allium sativum*	t- value
Moisture (fresh weight)	52.37±0.41	53.77±0.54	3.55^{NS}
Crude protein	6.21±0.15	4.85±0.07	13.96**
Total ash	1.39±0.04	1.66±0.01	11.32**
Crude fat	0.53±0.03	0.66±0.05	3.81^{NS}
Crude fiber	1.24±0.22	2.70±0.078	10.94**

Values are Mean±SD
** Significant at 1percent level ($p<0.01$)
NS- Non-significant

Mineral analysis

The minerals concentration present in *Allium ampeloprasum* and *Allium sativum* are depicted in **Table 2**. The composition of mineral content was higher in *Allium sativum* as compared to *Allium ampeloprasum* except for sodium. High significant difference ($p<0.01$) was observed between the two species. Mineral profile of *Allium ampeloprasum* showed that potassium was the major mineral with maximum quantity content (457.64±0.55 mg/100g) followed by sulfur (225.23±2.12 mg/100g), phosphorus (118.39±0.32 mg/100g), magnesium (18.58±0.32 mg/100g) and calcium (12.51±0.37 mg/100g). Other minerals like sodium, iron, zinc, manganese were content in lower quantities (6.79±0.15, 1.21±0.01, 0.65±0.03, 0.23±0.01 mg/100g) respectively. Chromium and copper contained in minute quantities.

Table 2 Mineral composition of *Allium ampeloprasum* and *Allium sativum* (Dry weight basis)

Mineral composition (mg/100g)	*Allium ampeloprasum*	*Allium sativum*	t-value
Calcium	12.51±0.37	16.63±0.26	15.67**
Phosphorus	118.39±0.32	133.64±0.27	63.90**
Magnesium	18.58±0.32	32.72±0.27	58.31**
Sodium	6.7±0.15	2.94±0.27	41.49**
Potassium	457.64±0.55	530±0.75	135.47**
Iron	1.21±0.01	1.7±0.01	76.82**
Zinc	0.65±0.03	0.93±0.03	12.62**
Manganese	0.23±0.01	3.63±0.25	23.45**
Sulphur	225.23±2.12	297.67±0.27	58.63**
Copper	0.96±0.02	1.46±0.04	19.07**
Chromium	0.22±0.01	0.56±0.03	21.89**

Values are Mean±SD.
** Significant at 1 percent level ($p<0.01$)

The results obtained from previous findings by Gracia-Herrera *et al* [12], reported that potassium (533.19±19.68 mg/100g) being the most abundant element in *A. ampeloprasum* followed by sodium (53.08±10.40 mg/100g), calcium (30.24±5.23 mg/100g), magnesium (8.88±1.08 mg/100g), iron (0.92±0.17 mg/100g), zinc (0.68±.02 mg/100g), copper (0.22±.03 mg/100g). Similarly, Dey and Khaled [8] also reported comparable mineral profiles i.e., potassium, sodium, magnesium, iron and zinc ranges 310, 9, 10, 1.10.4 mg/100g in *A. ampeloprasum*, respectively.

According to the present study, the mineral profile of *Allium sativum* showed that potassium content was the highest among the others mineral with 530±0.75 mg/100g, followed by sulfur (297.67±0.27 mg/100g), phosphorus (133.64±0.64 mg/100g), magnesium (32.72±0.27 mg/100g), calcium (16.63±0.26 mg/100g). Minerals like manganese, sodium, iron, zinc were content in lesser quantities (3.63±0.25, 2.94±0.27, 1.7±0.01, 0.9±0.03 mg/100g) respectively. Copper (1.46±0.04 mg/100g) and chromium (0.56±0.03 mg/100g) was found in the least quantities.

A similar mineral composition has been investigated by Khan *et al* [21], they reported that sodium, calcium, iron, phosphorus, zinc, copper, manganese and magnesium present in *A. sativum* samples were 4.54±0.61, 24.79±2.78, 3.79±0.80, 8.23±2.03, 0.47±0.07, 0.014±0.01, 0.02±0.02 and 2.69±0.47 mg/100g, respectively. The results of the present investigation was found to be higher in some mineral than the findings reported by Sajid *et al* [13], the values were potassium (54.65±1.74mg/100g), phosphorus (9.54±0.34 mg/100g), magnesium (3.97±0.13 mg/100g) while calcium, iron, sodium, zinc, manganese, and copper have similar values i.e., 19.83±0.83, 4.21±0.15, 4.1±0.18, 0.34±0.01, 0.016±0.0, 0.01±0.0 mg/100g respectively.

The comparison of mineral profiling between these *Allium* species showed a clear view that *Allium sativum* was significantly higher ($p<0.01$) than *Allium ampeloprasum* except for sodium content i.e., 2.94±0.27 and 6.79±0.15 mg/100g, respectively. Among all the minerals, potassium and sulfur content seems to be quite higher than others in both the species.

Heavy metal

Heavy metal are naturally occurring elements, which is defined as subsets of an element that exhibited metallic properties with relatively high atomic weight, having specific gravities equal to or greater than 5.0 g/cm [22].

The heavy metal present in *Allium ampeloprasum* and *Allium sativum* are listed in **table 3**. Heavy metals present in *A. sativum* were higher than *A. ampeloprasum* except for boron. The statistical analysis showed highly significant differences between the species except for cadmium. The arsenic, boron, cadmium, nickel, and lead present in *Allium ampeloprasum* ranged 7.42±0.03 µg/100g, 1.51±0.01 mg/100g, 2.31±0.01 µg/100g, 22.8±0.10 µg/100g and 10.1±0.1µg/100g, respectively. A similar mineral content has been reported by Hanen *et al* [23] in *Allium roseum*, the values were <0.01 in nickel, <0.04 in lead, <0.01 mg/100g in cadmium. Present investigation showed that *Allium sativum* contained 13.10±0.1µg/100g in arsenic, 0.53±0.01 mg/100g in boron, 2.32±0.3 µg/100g in cadmium, 32.4±0.1µg/100g in nickel and 12.5±0.1 µg/100g in lead. There was no significant difference was found in cadmium content in both the species. Arsenic, nickel and lead concentration were significantly higher in *Allium sativum* than *Allium ampeloprasum* whereas baron has higher mean value in *Allium ampeloprasum* and showed highly ($p<0.01$) significant difference. A study conducted by Ata and the co-workers [24] showed a higher concentration of lead and cadmium in *Allium sativum* ranged 4.9 to 94.6 mg/kg and 0.625 to 151.4 mg/kg, respectively in different locations of Punjab.

Table 3 Heavy metal content of *Allium ampeloprasum* and *Allium sativum*

Heavy metals	***Allium ampeloprasum***	***Allium sativum***	**t-value**
Arsenic (µg/100g)	7.42±0.03	13.10±0.1	93.61**
Boron (mg/100g)	1.51±0.01	0.53±0.01	149.11**
Cadmium (µg/100g)	2.31±0.01	2.32±0.3	0.88^{NS}
Nickel (µg/100g)	22.8±0.1	32.4±0.1	117.58**
Lead (µg/100g)	10.1±0.1	12.5±0.1	29.39**

Values are Mean±SD.
** Significant at 1percent level ($p<0.01$)
NS- Non-significant

Conclusion

It can be concluded that *A. ampeloprasum* showed high nutritional and health-enhancing properties and it can be comparable with *(Allium sativum)* garlic which is known for possessing high medical properties. *Allium ampeloprasum* showed high significant differences in crude protein content i.e., 6.21 percent and crude fat content was found to be very low. *Allium sativum* showed higher mineral content than *A. ampeloprasum*. Potassium was the highest mineral content in both *Allium* species followed by sulfur. Ample amount of phosphorus, magnesium and calcium was also found. Heavy metals content was found to be highly significant in *Allium sativum* than *Allium*

ampeloprasum but the values of all the heavy metals determined in the present investigation were below the tolerable limits recommended by World Health Organization [25].

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