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Evaluation of *Allium* species for elemental composition in Western Himalayan region

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ABSTRACT

The screening of elemental composition was carried out in five under explored *Allium* species namely *Allium auriculatum* Kunth, *Allium ampeloprasum* L., *Allium ascalonicum, Allium rubellum* M., Bieb. and Allium tuberosum L., which are distributed in temperate and alpine regions of Western Himalaya. The edible part i.e. leaves and bulbs of these species were analyzed separately for few minerals like sodium, potassium, calcium, phosphorus, sulphur, copper, zinc, iron, manganese and cobalt. Among these *Allium* species, maximum concentration of phosphorus, and sodium were found in the leaves of *A. ampeloprasum.* The leaves of *A. ascalonicum* were rich in calcium and manganese. Highest sulphur content was present in the leaves of A. auriculatum while, in its bulbs, maximum zinc was reported . Iron and copper were observed high in the bulbs of *A. rubellum.* This study showed that the leaves of *A. ampeloprasum* were rich source of minerals followed by *A. rubellum* bulbs and *A. ascalonicum.* The quantitative yield of *A. ampeloprasum, Allium rubellum* and *A. ascalonicum* were also found better than other species. Owing to important functional properties and their role in nutrition the *Allium* species can be exploited for commercial cultivation in Western Himalayan region.

Key words: Elemental composition, mineral composition, *Allium* species.

INTRODUCTION

In Western Himalaya, Allium is one of the important genuses of family Amarylliadaceae. It is widely distributed throughout the temperate and alpine regions. The wild Allium species have been utilized as spice and condiments, locally called Jamboo, Doona, Dunn, Dhun, Pharan etc.

Allium species are aromatic green, used in pulverized state, primarily for seasoning or garnishing food and beverages, characterized by pungency, strong odour, sweet and bitter taste. The leaves, bulbs and flowers of plant have been harvested, dried and used as condiment (Gaur *et al.,* 2). The local inhabitants of high altitude areas and shepherds usually collect these Allium species from its wild sources for consumption, while taking their herds to high altitude areas for grazing. Mostly these plants are used as condiments for seasoning various dishes either in fresh or dried form. The market value of these wild *Allium* species is very high and the cost of dried green parts of plants is sold around 300-400 rupees per kg. Due to over exploitation of these wild species, many highly demanded wild Allium species are at the stage of extinction.

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The influence of different cultivation practices viz. organic and conventional cultivation (with the use of fertilizers and pesticides) on 63 major and trace elements in 210 cultivars of onions (*Allium cepa* Hysam) had been studied by (Gundersen *et al.*, 3) and proved that cultivation method effects the concentration of some elements in the crop. The major elements like Na, K, Ca, Mg, p and Fe were determined in aqueous extract of *Allium sativum* (Mikail, 4).The comparison of nutritional quality and minerals in healthy and purple blotch infected leaves of *Allium cepa* was determined and observed that quantity of minerals were significantly higher in the healthy leaves than the diseased onion leaves (Shehu *et al.,* 7). The macro and micro elements are physiologically very important for human body, sodium and potassium have crucial role in maintaining blood pressure, calcium and phosphorus are essential for the formation of bones and teeth. Element sulphur maintains elasticity of various tissues of the body. Microelement iron is main component of hemoglobin, copper helps to oxidize glucose to release energy, zinc and manganese play important role in growth and cell division while, cobalt is essential for normal bone marrow function (Pandey, 5).

MATERIALS AND METHODS

The fully mature leaves and bulbs of Allium species viz. *Allium auriculatum, Allium ampeloprasum, Allium ascalonicum, Allium rubellum and Allium tuberosum* were collected from temperate and alpine regions of Western Himalaya, authentically identified and grown at Defence Agricultural Research laboratory, Field Station, Auli (Joshimath) , Chamoli (9000 feet altitude). The leaves and bulbs were taken from mature plants, washed, oven dried. The moisture free, dried samples were kept in airtight sample containers. One gram dried sample was first digested with 15 ml of triple acid mixture (10 part HNO_3+ 4 parts of $HClO_4$ + 2 parts H_2SO_4) at 110^0C and reduced to about 1.0 ml. The digested residue was dissolved in triple distilled water, filtered and diluted to 100 ml. This solution was used for the estimation of minerals. In similar condition, blank samples were also prepared and utilized as check. The samples of each of the cultivars were taken in three replications.

Reference standards were prepared from E. Merck, AAS Spectrosol (1000 mg L^{-1}). Estimation of element like Na, K, Ca and Li were carried out by AIMIL, Photoflame, photometer, New Delhi, while Fe, Co, Mn, Cu and Zn were determined by Atomic Absorption Spectrophotometer, model 4129, Electronic Corporation of India Ltd, Hyderabad (A.P.) (A.O.A.C., 1). The S and P were estimated by spectrophotometric methods. The instruments were calibrated by using standard solutions (0.20-10 mg L^{-1}) of above cited elements. The calculation of data was carried out on mg per 100 g dry wt. of *Allium* leaves and bulbs.

RESULTS AND DISCUSSION

The range of concentration and mean value of Na, K, Ca, P and S are given in Table 1, while micro elements Fe, Cu, Zn, Mn & Co are mentioned in Table 2.

It is evident from the data that potassium, calcium, phosphorus and sulphur are the most prominent minerals in concentration terms. Table 1 shows that, the concentration range of sodium varied from 11.01 mg to 269.48 mg/100 g. dry wt. of *Allium* leaves and bulbs. Highest concentration of sodium (269.48 mg) was found in the leaves of *A. ampeloprasum* followed by the bulbs (91.65mg) and least quantity (11.01mg) was present in the leaves of *A. rubellum*. Potassium on the other hand ranged between 628.29 mg to 3025.00 mg/100 g. Maximum concentration of potassium (3025.00 mg) was found in the leaves of *A. tuberosum* followed by (1808.32 mg) in the leaves of *A. auriculatum*. The calcium content ranged between 141.47mg to 697.06 mg/100 g. The leaves of *A. ascalonicum* reported highest calcium (697.06 mg), while lowest calcium (141.47 mg) was found in the bulbs of *A. tuberosum*. Concentration of phosphorus varied from 144.83 mg to 235.50 mg/100 g. In the leaves of *A. ampeloprasum* maximum phosphorus (235.50 mg) was reported followed (212.83 mg) in the bulbs of *A. rubellum*. Element sulphur was ranged between 34.67mg to 228.50 mg/100 g in different species. Highest sulphur (228.50 mg) was present in the leaves of *A. auriculatum* and least quantity (34.67mg) was observed in the bulbs of *A. tuberosum*. The concentration of minerals like Na, K, Ca, Mg, P and Fe were determined in the aqueous extract of *Allium sativum* (Mikail H.G.,4). He had reported potassium 1566.50 mg/kg, sodium 10.30 mg/kg, calcium 46.80 mg/kg and phosphorus 212.50 mg/kg but these values are quite low as compared to the reported values of different elements in the present study. The concentration of potassium 183.20 mg, calcium 133.15mg, iron 7.12 mg, copper 0.38 mg, manganese 0.36 mg and zinc 0.54 mg/100g fresh weight basis were recorded in the leaves of *Allium ampeloprasum* by earlier workers(Pandey *et al.*, 6), this values are almost similar to the present work when calculated on dry weight basis.

Micro-element iron ranged between 1.37 to 29.12 mg. Highest iron content (29.12 mg) was found in the bulbs of *A. rubellum* followed by (20.27 mg) in the leaves of *A. ascalonicum* while, least quantity of iron (1.37 mg) was observed in the bulbs of *A. ascalonicum*. Mikail H.G. in the year 2010 reported slightly higher value of iron (375.00 mg/100 g) in the aqueous extract of *Allium sativum.* The Copper content varied from 0.98 mg to 2.75 mg. Maximum copper (2.75 mg) was found in the bulbs of *A. rubellum* and least copper content (0.98 mg) was observed in the leaves of *A. rubellum*. Concentration of zinc ranged between 1.71 mg to 6.40 mg. In the bulbs of *A. auriculatum* maximum zinc content (6.40 mg) was reported, followed by leaves of *A. rubellum* (4.23 mg) while, least zinc (1.71mg) was found in the leaves of *A. ascalonicum*. Manganese content varied between 0.42 mg to 3.91 mg. Maximum concentration of manganese (3.91 mg) was present in the leaves of *A. ascalonicum*, followed by (3.40 mg) in the leaves of *A. ampeloprasum* and least quantity (0.42mg) was observed in the bulbs of *A. tuberosum.* Cobalt was in the range of 00.00 to 1.11mg. Highest cobalt concentration (1.11 mg) was found in the bulbs of *A. ampeloprasum* followed by its leaves (0.94 mg). the Cobalt was found absent or beyond detectable limit of instrument in *A auriculatum* and *A. tuberosum* species.

The results reveal that, in the leaves of *A. ampeloprasum* maximum quantity of phosphorous and

Table 1. Major elements in *Allium* species.

S. No.	Name of species	Plant part screened	Elemental composition (mg/100g dry wt.)									
			Sodium		Potassium		Calcium		Phosphorus		Sulphur	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
1.	*Allium auriculatum*	Leaves	19.90-21.40	20.65	1791.62-1825.03	1808.32	437.60-495.05	467.19	156.00-168.25	169.75	205.50-258.00	228.50
2.	*Allium auriculatum*	Bulbs	23.95-27.90	25.42	1213.04-1246.94	1225.99	151.00-189.57	170.78	143.00-207.00	176.17	83.00- 09.00	96.77
3.	*Allium ampeloprasum*	Leaves	265.89-273.50	269.48	971.47-1079.33	1010.80	651.12-670.83	659.81	169.50-275.00	235.50	103.00-113.00	107.67
4.	*Allium ampeloprasum*	Bulbs	89.50-93.27	91.65	633.56 -683.59	660.07	348.00-361.49	356.42	142.00-162.00	150.83	55.00-70.00	64.83
5.	*Allium ascalonicum*	Leaves	32.70-35.56	34.17	1655.16-1690.29	1655.16	607.28-786.83	697.06	183.00-193.00	189.33	172.00-189.00	176.33
6.	*Allium ascalonicum*	Bulbs	86.00-88.99	87.18	619.00-639.64	628.29	134.55-155.76	144.10	188.00-226.00	202.00	127.00-159.00	143.17
7.	*Allium rubellum*	Leaves	7.97-13.33	11.01	1242.25-1292.89	1266.80	614.45-635.25	626.59	161.00-170.00	165.00	82.00-90.00	86.00
8.	Allium rubellum	Bulbs	16.00-26.00	21.00	930.00-1040.00	985.00	267.30-286.00	276.77	176.00-249.00	212.83	59.00-66.00	62.33
9.	*Allium tuberosum*	Leaves	20.69-22.60	21.08	2991.13-3058.88	3025.00	327.05-378.99	348.99	137.50-152.00	144.83	44.00-55.00	49.17
10.	*Allium tuberosum*	Bulbs	2.33-3.39	21.55	834.50- 877.07	858.56	133.20-148.17	141.47	168.80-185.25	175.52	31.00-38.00	34.67
	CD at 5%			5.936		79.219		78.496		28.407		28.552
	CV (%)			4.180		2.56		8.580		11.522		11.580

Table 2. Micro elements in *Allium* species.

S. No.	Name of species	Plant part screened	Micro elemental composition (mg/100g dry wt.)									
			Iron		Copper		Zinc		Manganese		Cobalt	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
1.	*Allium auriculatum*	Leaves	19.50- 20.79	20.11	1.40-1.86	1.65	3.96-4.25	4.10	2.00-2.98	2.63	0.00-0.00	0.00
2.	*Allium auriculatum*	Bulbs	18.24- 20.65	19.97	1.58-1.87	1.73	6.08-6.61	6.40	1.23-1.65	1.37	0.00-0.00	0.00
3.	*Allium ampeloprasum*	Leaves	10.17- 16.45	12.91	1.45-2.62	1.85	2.62-2.93	2.82	2.96-3.53	3.40	0.48-1.37	0.94
4.	*Allium ampeloprasum*	Bulbs	5.98- 6.62	6.28	1.09-2.67	1.86	2.96-3.47	3.18	1.33-1.83	1.55	0.69-1.39	1.11
5.	*Allium ascalonicum*	Leaves	19.58- 21.22	20.27	0.79-1.35	1.07	1.38-2.05	1.71	3.60-4.24	3.91	0.20-1.36	0.60
6.	*Allium ascalonicum*	Bulbs	0.50- 1.92.	1.37	1.09-1.30	1.20	3.28-3.70	3.46	0.65-0.79	0.70	0.00-0.86	0.43
7.	*Allium rubellum*	Leaves	7.05- 9.42	7..98	0.97-0.99	0.98	3.97-4.76	4.23	2.76-2.96	2.88	0.00-0.00	0.00
8.	*Allium rubellum*	Bulbs	21.41 – 35.94	29.12	2.66-2.85	2.75	2.85-4.12	3.32	1.14-1.60	1.30	0.00-0.78	0.52
9.	*Allium tuberosum*	Leaves	11.04 – 14.62	12.82	1.18-1.49	1.35	3.90-4.16	4.00	1.34-1.80	1.52	0.00-0.00	0.00
10.	*Allium tuberosum*	Bulbs	5.68-8.46	7.08	0.93-1.16	1.05	3.00-3.76	3.37	0.23-0.60	0.42	0.00-0.00	0.00
	CD at 5%			6.498		0.836		0.788		0.691		1.610
	CV (%)			20.05		22.97		9.16		15.05		48.79

sodium, second highest concentration of calcium and manganese were recorded. The calcium and manganese were found highest in the leaves of *A. ascalonicum* while, it also contains good quantity of sulphur and iron. In *A. auriculatum* sulphur and zinc contents were present highest in leaves and bulbs respectively. Maximum amount of iron and copper were found in the leaves of *A. rubellum. A. tuberosum* was found rich in potassium content.

Hence it can be concluded that among five *Allium* species *A. ampeloprasum, A. ascalonicum* and *A. auriculatum* are superior cultivars for mineral contents. These species are also useful in cardiac disorders; the presence of ample concentration of minerals may be one of the reasons responsible for their medicinal superiority. Due to high economic value of these cultivars, they can be exploited for commercial scale cultivation in western Himalayan region.

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