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Mineral contents of some plants used in Iran

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ABSTRACT

In this work, mineral contents of 4 plants used in Iran were determined by Inductively Coupled Plasma-Atomic Emission Spectrometry. The concentrations were calculated on a dry weight basis. All materials contained high amounts of Na, Al, Ca, Fe, K, Mg, P, Zn, and I. On a moisture-free basis, the highest levels of Ca, P, and Mg were found in spinach to be 3200 mg/100 g, 2150 mg/100 g, and 460 mg/100 g, respectively. Bi, Cd, Li, Pb, and Se contents of condiments were found to be very low. The results were compared with those from the Spanish, Turkish, and Indian. This work attempts to contribute to knowledge of the nutritional properties of these plants. These results may be useful for the evaluation of dietary information and concluded that the green vegetables are the good sources of minerals.

Key words: Green vegetables, ICP-AES, mineral contents, nutritional properties

INTRODUCTION

There is a growing interest in the mineral content of foods and diets. In the earlier part of this century, scientists could qualitatively detect small amounts of several mineral elements in living organisms. The trace elements found in living organisms may be essential, that is, indispensable for growth and health, or they may be nonessential, fortuitous reminders of our geochemical origins or indicators of environmental exposure. Green vegetables, grown wildly in various regions of the world, have been used for several purposes since ancient times.[1] Leafy vegetable preparations include the raw salad, widely known all over the world, in partially or completely cooked or fried forms. Iranian cuisine has a wide range of choice among the leafy vegetables. In most Iranian households, the inclusion of a leafy vegetable preparation in daily diet is an accepted practice. These green leafy vegetables are inexpensive, are easily and quickly cooked, and are rich in several nutrients, such as vitamins, minerals, proteins, and others.[2]

They have reported that green leaves are a good source of available calcium. The main problem in nutritional exploitation of green leafy vegetables is the presence of antinutritional and toxic principles. The nutritional and medicinal properties of these plants may be interlinked through phytochemicals, both nutrient and nonnutrient.[3] Although spices are used primarily for their desirable flavor and odor, they may play other important roles in the food systems. From antiquity, in addition to spices and their derivatives being used for flavoring foods and beverages and for medication, they have also been highly valued for their use as antimicrobials.[4,5] Human, as well as animal, studies originally showed that optimal intake of elements, such as sodium, potassium, magnesium, calcium, manganese, copper, zinc, and iodine, could reduce individual risk factors, including those related to cardiovascular disease.[6-8] Throughout the world, there is increasing interest in the importance of dietary minerals in the prevention of several diseases. Minerals are of critical importance in the diet, even though they comprise only 4–6% of the human body. Major minerals are those required in amounts greater than 100 mg per day and they represent 1% or less of body weight. These include calcium, phosphorus, magnesium, sulfur, potassium, chloride, and sodium. Trace minerals are essential in much smaller amounts, less than 100 mg per day, and make up less than 0.01% of body weight. Essential trace elements are zinc, iron, silicon, manganese, copper, fluoride, iodine, and chromium. The major minerals serve as structural components of tissues and function in cellular and basal metabolism and water and acid–base balance.[9-11]

Several studies have been carried out on green vegetables, but there are limited studies on mineral contents of green

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vegetables in Iran. The aim of this study was to determine the mineral contents of several green vegetables used for several purposes in Iran.

MATERIAL

Green vegetables were purchased from local markets in Tehran, Iran. All the products were washed with deionized water to remove the dust and soil particles and the fertilizers and spray residues. This procedure could, however, also lead to problems if washing of the plant tissues leached out some nutrients, for example, potassium. As a safeguard against contamination during the preparative phase, all utensils with grinding parts made of elements, such as iron and copper were avoided.[8]

The dried materials were then ground in a mortar and the ground material sealed in bottles for storage until analysis. The common, scientific, and family names of the spices are given in Table 1.

METHODS

Determination of Mineral Contents

About 0.5 g dried and ground sample was put into a burning cup and then was incinerated in an oven at 550°C (approx 4 h). The ashed residue was extracted with 5 ml pure HNO_3, transferred to a volumetric flask, and was diluted to a certain volume with water. Concentrations were determined with an Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES).[12]

Working conditions of the ICP-AES were

Instrument ICP-AES (Shimadzu, model ICPS – 700, ver. 2)
RF Power 1.0 kW
Coolant gas flow rate (Ar) 8 L/min
Auxiliary gas flow rate (Ar) 0.6 L/min
Purge gas flow rate (Ar) 0.3 L/min
Carrier gas flow rate (Ar) 0.6 L/min
Viewing height 12 mm

Table 1: Green vegetables used in the experiment

General name	Botanical name	Family name
Spinach	*Spinacea oleracea* L.	Chenopociaceae
Parsley	*Petroselinum crispum* (Mill.)	Apiaceae (Umbelliferae)
Dill	*Anethum graveolens* L.	Umbelliferae
Mint	Menthe spp.	Lamiaceae (Labiaceae)

RESULTS AND DISCUSSION

The mineral compositions of condiments are shown in Table 2. The results of the analyses were established to give nutrient values per 100 grams of used portion of dried weight. Mineral elements were found to vary widely depending on the different spices. According to results, Na, Al, Ca, Fe, K, Mg, P, Zn and I contents were very high in all the vegetables. In addition, Cu, Mn, Co, and Cr elements were found in a similar range for all plants.

In this work, potassium was abundant in all species. On a moisture-free basis, the level of K in spinach was found to be higher than those of others (7400 mg/100 g). The highest levels of P, Ca, and Mg were found in spinach to be 3200 mg/100 g, 2150 mg/100 g, and 460 mg/100 g, respectively. The maximum amount of zinc in spinach and the maximum amount of iron in mint were determined to be 77.5 mg/100 g and 220 mg/100 g, respectively. Parsley was the richest in manganese contents. Copper contents of spices were found in similarly small percentages in all the species analyzed, ranging from 2.5 mg/100 g in spinach to 1.42 mg/100 g in parsley. Selenium content varied from 0.7 mg/100 g in dill to 1.88 mg/100 g in parsley. Cr, Ni, Mo, and V contents were found to be very similar to those of other species.

Table 2: Mineral contents of plants

Plant name	K	Ca	Na	P	Mg	S	Si	Fe	Sn	Zn	Cu
Spinach	7400	2150	550	3200	460	6.43	400	99	4.65	77.5	2.5
Parsley	6750	2000	250	1660	275	6.2	320	110	4.46	22.5	1.42
Dill	7200	1780	480	1460	194	2.4	260	104	1.3	40	1.84
Mint	7300	1850	194	1340	305	5.8	610	210	4.33	1.61	2.25
Plant name	**I**	**Cr**	**Co**	**B**	**Cd**	**V**	**Se**	**Mn**	**Ni**	**Mo**	**Al**
Spinach	108	0.7	0.177	24.5	0.156	0.133	1.65	20	0.51	0.315	50
Parsley	140	0.88	0.17	19.5	0.124	0.13	1.88	28.5	1.76	1.15	65.5
Dill	130	0.84	0.076	20	2.6	0.74	0.7	26	0.6	0.84	54
Mint	185	1.04	0.175	16.3	0.096	0.265	1.27	26	1.16	0.4	142

Values given in mg/100 g.

The determination of heavy metals in environmental, biological, and food samples has drawn a significant attention due to the toxic and nutritional effects of these elements or their compounds.[13] Pb and Cd can be accumulated in biological systems becoming potential contaminants along the alimentary chain. These elements produce harmful effects on the human health, affecting several organ systems, such as the nervous, gastrointestinal, reproductive, and skeletal, and biochemical activities. Bi, Cd, Li, Pb, and Se contents of vegetables were very low. The heavy metals of vegetables are shown in Table 3.

Bi, Cd, Li, and Pb are elements of immediate concern due to their potential toxicity for living organisms, depending on the permissible daily dose for different toxic elements.[14,15]

In this work, the mineral contents of the stem of parsley, dill, and mint were determined and compared with those of leaves [Table 4]. The level of K in the stems of vegetables was significantly more than those in the leaves, but the levels of Fe, Mg, and Ca in the leaves were found to be higher.

Table 5 presents a comparison of the minerals of the Iranian data with those of spinach from the India, Turkey, and Spain.[2,13] To overcome the potential problems of comparison because of different water contents, the data are expressed in terms of dry weight. In general, no consistent differences were shown in the mineral content, although the mineral content of Iranian spinach seemed higher, except for Na and Mg. The Na content of Indian spinach was also 7 times greater than the Iranian variety, but this gradient was not observed in the rest of the elements analyzed. These differences might be due to growth conditions, genetic factors, geographical variations and analytical procedures.[5,13]

Potassium is the principal intracellular cation and mainly involved in membrane potential and electrical excitation of nerve and muscle cells.[16] Magnesium is the most abundant intracellular divalent cation. It is an essential cofactor for a multitude of enzymatic reactions that are important for the generation of energy from ATP and for physiologic processes, including neuromuscular function and maintenance of cardiovascular tone.[17] Calcium is the major component of bone and assists in teeth development.[18]

This study confirmed the well-known fact that green vegetables have an important role in the diet. Dietitians should acknowledge the contribution of alternative foods in the diet when analyzing menus and making recommendations for dietary improvements. As nutrition experts, dietitians have a responsibility to create and recommend balanced and healthful menus, while respecting the cultural needs and mores of the populations they are serving. The individual plant analyses are therefore necessary when estimating the true intake of the population. The intake of these vegetables could be expected to contribute a large proportion of the mineral requirement in the body.

Table 3: Heavy metals of plants

Plant name	Pb	Cd	Bi	Li
Spinach	3.3	0.156	0.77	4.49
Parsley	1.01	0.124	0.72	0.84
Dill	0.76	2.6	0.34	7.8
Mint	1.12	0.069	0.9	7.05

Table 4: Comparison of mineral contents in leaf and stem

Plant name	K		Na		Ca		Mg		Fe	
	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf
Parsley	22,000	6750	860	250	980	2000	220	275	32	110
Dill	20,000	7200	1300	480	1360	1780	192	194	38	104
Mint	13,400	7300	220	194	1280	1850	280	305	190	210

Values given in mg/100 g.

Table 5: Comparison of mineral contents of Iranian, Indian, Spanish, and Turkish spinach

Countries	K	Ca	P	Mg	Na	Fe	Zn	Cu
Iran	7400	2150	3200	460	550	99	77.5	2.5
India	1170	870	740	770	3818	35	4.25	0.83
Turkey	470	93	51	66	71	3.1	-	-
Spain	1170	870	51	58	54	4.1	0.5	0.12

Values given in mg/100 g.

REFERENCES

1. Ozcan M. Mineral contents of some plants used as condiments in Turkey. Food Chem 2004;84:437- 40.
2. Gupta K, Wagle DS. Nutritional and antinutritional factors of green leafy vegetables. J Agric Food Chem 1998;36:472-4.
3. Ranhotra GS, Leinen, SD, Vinas MA, Lorenz KJ. Nutritional profile of some edible plants from Mexico. J Food Compost Anal 1998;11:298–304.
4. Koedam A. Volatile oil composition of Greek mountain tea. J Si Food Agric 1986;36:681-4.
5. Ozcan M, Akgu¨ l, Bag˘ci Y, Dural H. Chemical composition and mineral contents of edible wild plants consumed in Icel (Mersin). S U Sci J 1998;15:72–7.
6. Anke M, Groppel B, Kronemann H. Significance of newer essential trace elements (like Si, Ni, As, Li, V) for the nutrition of man and animals. 1984.
7. Mertz W. Trace minerals and atherosclerosis, Fed Proc 1982;41:2807–12.
8. Sanchez-Castillo CP, Dewey PJ, Aguirre A, Lara JJ, Vaca R, Leon de la Barra P, *et al*. The mineral content of Mexican fruits and vegetables. J Food Compost Anal 1998;11:340–56.
9. Macrae, R., Robinson, R. K., Sadler, M. J. (Eds.). Encyclopaedia of food science. Food technology and nutrition. 1993. p. 5.
10. Nielsen FH. Ultratrace elements in nutrition. Annu Rev Nutr 1984;4:21–41.
11. Smith KT. Trace minerals in foods. New York: Marcel Dekker;. 1988:19:429-54.
12. Skujins S. Handbook for ICP-AES (Varian-Vista). Varian Int. AG, Zug; 1998. p. 1.
13. Guil JL, Martinez JJ, Isasa ME. Mineral nutrient composition of edible wild plants. J Food Compost Anal 1998;11:322–8.
14. Concon JM. Food Toxicology. Marcel Dekker Inc; 1988. p. 1049–73.
15. Phaneuf D, Cote I, Dumas P, Ferron LA, LeBlanc A. Evaluation of the contamination of marine algae (seaweed) from the St. Lawrence River and likely to be consumed by humans. Environ Res 1999;80:S175–82.
16. Vaskonen T. Dietary minerals and modification of cardiovascular risk factors Institute of Biomedicine, University of Helsinki, Helsinki, Finland. J Nutr Biochem 2003;14:492–506.
17. Saris NE, Mervaala E, Karppanen H, Khawaja JA, Lewenstam A. Magnesium: An update onphysiological, clinical and analytical aspects. Clin Chim Acta 2000;29:1–26.
18. Brody T. Nutritional Biochemistry. San Diego, CA: Academic Press; 1994.

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