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Determination of Iranian Almond, Peanut and Hazelnut Mineral Contents

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ABSTRACT

Evaluation of mineral concentration was performed on Iranian Almond (prunusdulcis), Hazelnut(Corylusavellana) and Peanut (arachishypogaea). Levels of Na, K, Ca, Mn, Cr, Zn, and Fe in the cultivars, and their regional water and soil were analyzed by Atomic absorption spectroscopy. The sequence of mineral contents in almond and hazelnut cultivars was K (216.01, 186.04)> Ca (16.49, 20.84)> Fe(10.9, 10.1)> Zn(3.7,6.3)> Na(1.68,4.81)> Mn(0.56, 0.93)> Cr(0.12,0.48 mg/100g), and in peanut was K(212.7)>Fe(39.96)> Na(8.34)> Zn(6.38)>Ca(3.84)> Mn(0.13)> Cr(0.44 mg/100g). Differences in the level of mineral contents in the cultivars might have been related to different fertilizers, cultivation methods, soil constitution and geographical conditions. There are high amounts of Fe, Zn, Mn, Ca and Cr in Iranian almond, peanut and hazelnut and the cultivars have high nutritional value and daily consumption of these nuts can supply some of the needed dietary mineral intake.
Key words: Iranian, Almond, Peanut, Hazelnut, Mineral Contents.

INTRODUCTION

Nuts are nutrient dense foods rich in unsaturated fatty acids and other nutritional compounds such as protein, carbohydrate, fiber and minerals. Nuts are highly beneficial to human health because of their unique composition [1-3]. Epidemiologic studies have indicated that nut consumption associated with a reduced incidence of coronary heart disease, gallstones and diabetes. Different researches suggest beneficial outcomes on cancer, hypertension, oxidative stress, inflammation, vascular reactivity, Blood pressure, visceral adiposity and the metabolic syndrome [4-6].

Optimum geographical conditions in Iran have led to the growth of about 8000 herbal species in the country. Different kinds and varieties of nuts are grown in different areas of Iran since the arrival of the early settlers. The most successful kinds of nuts that can be grown in Iran include: Almond (prunusdulcis, rosaceae family), Peanut (arachishypogaea, legominaceae family), Hazelnut(Corylusavellana L, Betulaceae family) and pistachio (Pistaciavera, Anacardiaceae family)

Iran has about 76000 hectares of land under almond cultivation, 35000 hectares under peanut and 10000 hectares under hazelnut. East-Azarbayjan, Bakhtiyari, kerman, Malayer, Tehran, Lorestan and Borujerd are important rejoins for almond cultivation and almost 80 percent of the almond exports are supplied from Azarbayjan. About 6.7% of the yearly 140,000 tons of peanut production is from Gilan Province. Hazelnut is cultivated in some regions such as Gilan, Azarbayjan, Mashhad, Ghom, Zanjan and Ghazvin ;Gilan has 10000 hectares from 19300 hectares of total hazelnut cultivation lands in Iran [7].

Analysis of micronutrients in foods, a prominent area in food chemistry, is of great interest not only regarding nutrition but also regarding the commercial aspects. On the other hand water and soil of the cultivation regions have an important role on quality and quantity of micronutrient compounds (such as minerals, vitamins, fatty acids and amino acids) in almond, peanut and hazelnut. There have been numerous studies on the analysis of micronutrient levels of nuts in some countries such as USA, Spain, China, and Turkey, but Iranian studies have been limited to evaluation of Fe, fatty acids and protein contents [8-14].

Considering the lack of data related to the levels of mineral contents in Iranian almond, peanut and hazelnut, the current study was conducted to measure amounts of Na, K, Ca, Mn, Cr, Zn and Fe in the cultivars and their regional water and soil.

MATERIAL AND METHODS

Almond samples were taken from Damavand, Tehran, peanut samples from Keshly village, Gilan and hazelnut samples from Alamut, Ghazvin. Water and soil samples of these lands were also used for detailed analysis. The nut, water, and soil samples were packed in polyethylene bags and care was taken to avoid any contamination. Almond,

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peanut and hazelnut samples were washed thoroughly with tap water and then with deionized water to remove dust and pollutions. Dry digestion method was used to determine Na, K, Ca, Mn, Cr and wet digestion was used to analyze Zn and Fe. All analyses were conducted in duplicate.

Dry digestion

The fruit was ground to a fine powder with mortar and pestle and then 2 gm of the sample was placed into a high form porcelain crucible. The furnace temperature was slowly increased from room temperature to 700˚C in 1 hr. The sample was ashed for about 4 hr until a white ash residue was obtained. The residue was dissolved in 50 ml of distilled water and then was centrifuged for 15 minutes at 10000 RPM (centurine-k241). Supernatant concentration was read by spectrophotometer (Atomic absorption spectrometer Shimadzu, AA-680).The process was performed for each fruit.

Wet digestion

The fruit was groundto a fine powder with mortar and pestle and then 2gm of the sample was dissolved in 5 ml distilled water and boiled for ten minutes. Wet digestion of samples was performed byan acid mixture of HNO3/HCl (1/1) (10 ml of each sample) in a 100ml beaker inside a hood. This mixture was brought to a volume of 25 ml with distilled water and was centrifuged for 15 minutes at 10000 RPM. Supernatant concentration was read by spectrophotometer. The process was performed for each fruit.

Determination of soil samples

Soil samples were determined by an acid mixture of HClO4/H2SO4/HNO3 (1/1/3) in a 100-mL beaker inside a hood. The mixtures were brought to a volume of 100 ml each, with distilled water and centrifuged for 15 minutes at 10000 RPM. Supernatant concentration was read by spectrophotometer.

Determination of Water samples

Water samples were determined by an acid mixture of HCl/HNO3 (1/1) (0.25ml/0.25ml) in a 25mL beaker inside a hood. The mixtures were brought to a volume of 20 ml each, with distilled water. The concentrations were read by spectrophotometer.

RESULTS AND DISCUSSION

Nuts are known to be concentrated foods for human diet because of their major and mineral contents , they are of the best sources of essential elements, amino acids, vitamin B [14] and supplies of natural antioxidants [15,16]. Minerals have pivotal roles in human health. They provide structure in forming bones and teeth, helping to maintain normal heart rhythm, muscle contractility, neural conductivity, and acid-base balance. They regulate cellular metabolism by becoming part of enzymes and hormones that modulate cellular activity [14]. Fe is an important element in hemoglobin, myoglobin, and a large number of enzymes,therefore it is an essential mineral in daily diet [17]. About 30% of iron in human body is as the storage form or ferritin and just a small level is associated with blood transport protein transfer. Zn as an essential element is a constituent of metabolic enzymes [18] and there is high amount of Zn in bones and muscles. Manganese, another essential element, plays an important role in structure and function of some enzymes [19] Chromium, an essential cofactor in insulin, has an important role in Glucose metabolism. Na as an important electrolyte and essential ion in the extra cellular fluid (ECF) playsa key role in enzyme function and muscle contraction. In addition, it is important for osmosis regulation and fluid maintenance of the human body. Other roles of sodium include heart performance, nervous system and glucose absorption. K is the third most abundant mineral in human body which is acting as an electrolyte. This mineral is needed for keeping heart, brain, kidney, muscle tissues and other important organs of human body in good state. Potassium chloride is the principal variety of K amongst others. It works in association with sodium to perform a number of critical body tasks. About 2% of total body weight of human body is consisted of Calcium. Ca is found in the bones and teeth in large volumes and its Traces are present in the circulatory system, which prevents life threatening hemorrhages [20,21].

In the current study the mineral contents of Iranian almond, hazelnut and peanut were analyzed by using atomic absorption technique. The results of almond mineral content analysis are listed in table 1. The sequence of mineral contents was K^{+}> Ca^{+2}> Fe^{+2}> Zn^{+2}> Na^{+}> Mn^{+2}> Cr^{+3}. Mineral contents of nuts depend on their soil, water and geographical conditions. The soil in Damavand region contains high levels of Ca^{+2} and Fe^{+2} (11915.40, 439.22 mg/100g respectively). The water for cultivation is supplied from the wells in this region which contains high

amount of Na^+. Therefore the mineral content of Almond in Dmavand has high levels of Ca^{+2} , Fe^{+2} and Na^+ because of its soil and water conditions.

Iron level in Malayer and Shiraz almonds are 4.78% and 4.83% respectively, as reported in previous studies [21]. Another study on almond mineral contents analysis, Amigdalus Scoparia cultivar, distributed in Isfahan, Yazd, Kermanshah and Dezful showed low amounts of iron in this cultivar because of the difference in water and soil conditions [21]. Table 2 shows the comparison of the two cultivars. Table 3 shows the comparison of almond mineral contents between Damavand and Chinese cultivars. There are many differences between the cultivars which might be related to the geographical conditions [13].

Analysis of mineral contents in hazelnut showed high levels of potassium, calcium and iron, 186.04,20.84, 10.1 mg/100g respectively (table 4). These findings related to the high amounts of Ca, Fe, and K in the soil of Alamut, the land of hazelnut cultivation. Yassi Badem, a cultivar with good quality in Turkey, was compared to Alamut cultivar in Iran. As indicated in table 5, the mineral contents of Yassi Badem are similar to those of Alamut cultivar , high amounts of K and Ca(382 mg/100g and 174 mg/100g respectively) and low amount of Mn (4.8 mg/100g). Another comparison was done between hazelnut of Ordu region in Turkey with hazelnut of Alamut [14] . Many differences were found in amounts of Zn, Na and Mn in Ordu region compared to those of Alamut cultivar(6.34, 4.81, 0.93 mg/100g) and (1.95, 0.7, 6.1 mg/100g) respectively [15]. Water, soil conditions and chemical fertilizers have high impact on values of elements in these cultivars. Results of another study done in Turkey on hybrid species of hazelnut are shown in table 5. K, Ca and Mn levels are higher than those of Alamut cultivar but hazelnut of Tambul region in Turkey has more amount of Mn than Alamut cultivar (6.45 and 0.93 mg/100g respectively) [14].

Table 6 shows analysis of mineral contents in peanut in Keshly region in the north of Iran. This kind of peanut has high levels of K, Fe and Na compared to the other minerals(212.7, 39.96 and 8.34 respectively). It might be because of high amount of these elements in Keshly's soil. There is significant relation between mineral contents of peanut with those of soil, water, and geographical conditions. The study was conducted in Sudan on mineral content analysis of peanut showed the high levels of K(630 mg/100g), Ca(167mg/100g) and Na(210mg/100g) as compared with the amounts of these elements in Keshly's cultivar(212.7, 3.84 and 8.34 g/100g respectively) [21]. It might be because of using biological fertilizers for cultivation and soil, water and geographical conditions in Sudan. The findings of the current study indicated high levels of Zn, Fe and Cr compared to the peanut cultivated in Spain(6.38, 39.96, 0.44 g/100g vs. 0.05, 0.04, 0.00006 mg/100g) [12]. Fe and Zn contents of Keshly peanut was about 6.8 and 1.09 times higher than reported values for the peanut cultivar in Brazil. Fe contents in Chinese and American cultivars have been reported 1.7 and 2.4 mg/100g respectively. In the current study Fe level was 39.96 mg/100g which is 23.5 times higher than that of Chinese cultivar and 16.5 times higher than that of American cultivar. These differences are related to geographical conditions.

The minerals in almond, hazelnut and peanut are very useful for human health. Using these nuts in diet prevents mineral deficiencies complications. According to the present study results, the minerals can supply some of the dietary intake. Table 7 shows an average of dietary mineral intake by consumption of 100 g almond, hazelnut and peanut.

Table 1. Mineral contents of Damavand almond

Elements	Almond(mg/100g)	water(mg/100g)	soil(mg/100g)
Na	1.68	3.52	18.44
K	216.01	0.07	77.5
Fe	10.908	0.02	439.11
Zn	3.77	0.06	3.86
Cr	0.12	0.009	0.66
Mn	0.56	0.0009	36.6
Ca	16.49	0.06	11915.40

Table 2. comparison of mineral contents in Amygdalus Scoparia and Amygdalus Dulcis

Minerals	Amygdalus Scoparia (mg/100g)	Amygdalus Dulcis (mg/100g)
Fe	4.7	10.9
Na	78	216.01
K	5.1	1.86
Ca	250	16.49

Table 3.mineral contents of Chinese and Damavand almond

Minerals	Damavand	Chinese
Na	1.68	2.55
K	216.01	866.38
Fe	10.9	37.21
Zn	3.77	7.79
Mn	0.56	0.6
Ca	16.49	193.75

Table 4. mineral contents of Alamut hazelnut.

elements	hazelnut(mg/100g)	water(mg/100g)	soil(mg/100g)
Na	4.81	1.016	6.14
K	186.04	0.14	155.25
Fe	10.1	0.04	817.66
Zn	6.33	0.02	5.75
Cr	0.48	0.01	0.58
Mn	0.93	0.001	44.37
Ca	20.84	0.26	1802.2

Table 5. comparison of mineral contents in 4 hazelnut cultivars

Mineral	Yassi Badem	Hybrids	Tombul	Alamut
K	382	415	-	186.04
Ca	174	152	-	20.84
Fe	3.2	4.4	4.9	10.1
Zn	2.2	2.3	2.2	6.3
Na	2.42	2.1	-	4.81
Mn	4.8	1.4	6.45	0.93
Cr	-	-	0.48	0.48

-: mineral analysis wasn't done.

Table 6: mineral contents of Keshly peanut

elements	peanut(mg/100g)	water(mg/100g)	soil(mg/100g)
Na	8.34	0.53	17.48
K	212.77	0.08	27.71
Fe	39.96	0.04	1614.6
Zn	6.38	0.01	2.82
Cr	0.44	0.003	0.94
Mn	0.13	0.0009	48.19
Ca	3.84	0.53	68.79

Table 7: average of diatery mineral intake by consumption of 100g almond,hazelnut and peanut.

Mineral	Almond(%)	hazelnut(%)	peanut(%)
Fe	77	56	28
K	10	9	9
Zn	29	53	67
Na	0.4	1	0.6
Cr	18	21	5
Ca	6	3	0.4
mn	28	46	45

CONCLUSION

In conclusion, the mineral contents of Iranian almond and hazelnut had similar sequences of minerals K^{+}> Ca^{+2}> Fe^{+2}> Zn^{+2}> Na^{+}> Mn^{+2}> Cr^{+3} and for peanut it was K^{+}>Fe^{+2}> Na^{+}> Zn^{+2}> Ca^{+2}> Mn^{+2}> Cr^{+3}. According to the results of the present study, there are high amounts of essential elements K^{+}, Ca^{+2}, Fe^{+2}, Zn^{+2} and Cr^{+3} in Iranian almond, peanut and hazelnut. The levels of mineral change according to varieties, and it may be related to differences in use of fertilizers, cultivation and irrigation methods, soil composition, climate, and geographical conditions.

Contributorship: all authors made substantial contributions to conception and design of the study, data analysis and interpretation and writing manuscript.

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