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Determination of Chemical Properties of Walnut (*Juglans regia* L.) Cultivars Grown in Turkey

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Potassium, phosphorus, magnesium and iron are found in significant quantities in Persian walnuts (*Juglans regia*). The concentrations of some of the nutrients of different walnut cultivars were determined by flame atomic absorption spectrometry after microwave digestion. Major nutrients found in these cultivars were in the range of 170–419 and 102–146 mg/100 g for potassium and magnesium respectively. The contents of other minerals found were between 202–453 for calcium, 1.2–6.9 for iron, 1.2–3.8 for zinc, 0.5–2.2 for copper, 0.4–3.5 for sodium and 1.2–6.0 for manganese as mg/100 g.

Key Words: Walnut, Chemical properties, Atomic absorption spectrometry.

INTRODUCTION

Walnuts are considered to be a rich source of dietary minerals and a good source of vitamins. Potassium, phosphorus, magnesium and iron are found in significant quantities in walnut. Walnut kernel could play an important role in pectic-rich diets designed to lower blood cholesterol levels and possibility of heart disease. Frequent nut consumption is associated with lower rates of coronary artery disease. Also, nut-rich diets improve the serum lipid profile of participants in dietary intervention trials. Other potentially protective constituents include vegetable protein, magnesium, vitamin E, fibre and potassium[1–5].

The chemical properties of commonly grown walnuts are known. However, new breeds or selected new cultivars may promise superior characteristics, particularly in their chemical properties. There has been no significant study in this area to explore these opportunities. Especially, if you consider the effect of nutritional value of walnut, investigation of chemical properties of newly grown

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Turkish walnuts became a necessity. Also, these findings may help to provide the importance of walnut consumption and higher economic value for walnut growers. The objective of our study is to investigate the concentrations of mineral nutrients of newly grown Turkish walnut cultivars.

EXPERIMENTAL

All reagents were of analytical reagent grade unless otherwise stated. Double deionised water (Milli-Q Millipore 18.2 MΩ cm^{-1} resistivity) was used for all dilutions. HNO_3 and H_2O_2 were of supra pure quality (E. Merck). All the plastic and glassware were cleaned by soaking with the contact overnight in a 10% (w/v) nitric acid solution and then rinsed with deionized water. The element standard solutions used for calibration were produced by diluting a stock solution of 1000 mg/L of the given element supplied by Sigma and Aldrich. A Perkin-Elmer Analyst 700 model atomic absorption spectrometer with deuterium background corrector was used in this study for elemental analysis. All measurements were carried out in an air-acetylene flame.

Sampling

For each variety, a sample (200 g) was taken randomly from the 3 kg package and rapidly ground into a fine powder with a plastic food processor. The samples were dried at 105°C for 24 h. Dried samples were stored in polyethylene bottles until analysis.

Analytical procedure

Samples (1.0 g) were digested with 6 mL of HNO_3 (65%), 2 mL of H_2O_2 (30%) in microwave digestion system for 31 min and diluted to 10 mL with deionized water. A blank digest was carried out in the same way (digestion conditions for microwave system were applied as 2 min for 250 W, 2 min for 0 W, 6 min for 250 W, 5 min for 400 W, 8 min for 550 W, vent: 8 min, respectively). This procedure was preferred because of more accuratcy with respect to both time and recovery values. The recovery values were nearly quantitative (> 95%) for the above digestion method.

RESULTS AND DISCUSSION

Mineral compositions of walnut varieties are shown in Table-1. Potassium content of varieties was in the range of 170–419 mg/100 g. Mg was found in the range between 102–146 mg/100 g. The amounts of minerals (mg/100 g) reached 202–453 for calcium, 1.2–6.9 for iron, 1.2–3.8 for zinc, 0.5–2.2 for copper, 0.4–3.5 for sodium and 1.2–6.0 for manganese. Mineral composition of the investigated cultivars showed high levels of potassium, magnesium, calcium and low levels of sodium. Cultivar Maras-10 contains higher content of iron and copper than other Turkish varieties. Cultivar Mert has the highest potassium content of all cultivars. The content of magnesium is the highest in cultivar Bursa-95.

TABLE-1
MINERAL CONCENTRATIONS (mg 100 g^{-1}) OF THE 18 WALNUT CULTIVARS

Cultivar	K	Mg	Ca	Fe	Zn	Cu	Na	Mn
Hartley	398 ± 31	110 ± 11	**414 ± 39**	3.7 ± 0.3	**3.8 ± 0.3**	**2.2 ± 0.2**	2.5 ± 0.2	3.8 ± 0.3
Pedro	396 ± 38	123 ± 10	262 ± 26	1.4 ± 0.1	2.5 ± 0.2	0.9 ± 0.01	2.2 ± 0.4	1.3 ± 0.1
Chandler	402 ± 89	125 ± 12	303 ± 29	1.6 ± 0.1	2.0 ± 0.1	0.8 ± 0.02	2.7 ± 0.2	4.3 ± 0.4
Serr	364 ± 33	122 ± 11	357 ± 30	4.3 ± 0.4	2.6 ± 0.2	0.9 ± 0.01	0.7 ± 0.01	5.2 ± 0.4
Seker-7	348 ± 31	121 ± 12	244 ± 23	1.9 ± 0.1	2.3 ± 0.1	0.8 ± 0.01	0.6 ± 0.01	5.1 ± 0.4
Sebin	347 ± 32	146 ± 13	319 ± 29	1.9 ± 0.1	1.9 ± 0.1	0.9 ± 0.01	1.2 ± 0.1	2.3 ± 0.2
Bilecik	371 ± 33	114 ± 10	345 ± 34	2.4 ± 0.2	1.9 ± 0.1	1.2 ± 0.1	0.6 ± 0.01	2.2 ± 0.1
Mert	**416 ± 40**	115 ± 11	271 ± 26	1.4 ± 0.1	1.7 ± 0.1	0.7 ± 0.02	1.0 ± 0.1	3.2 ± 0.3
Seker-1	170 ± 16	102 ± 9.0	218 ± 21	1.6 ± 0.1	1.6 ± 0.1	0.9 ± 0.01	0.8 ± 0.01	2.6 ± 0.2
Seker-2	356 ± 33	110 ± 10	202 ± 20	1.6 ± 0.2	1.2 ± 0.1	0.6 ± 0.01	2.5 ± 0.2	1.5 ± 0.1
Seker-3	339 ± 32	106 ± 09	209 ± 20	1.8 ± 0.1	1.9 ± 0.1	0.9 ± 0.01	1.4 ± 0.1	2.6 ± 0.2
Seker-9	342 ± 32	131 ± 13	**453 ± 44**	1.2 ± 0.1	1.3 ± 0.1	0.6 ± 0.01	3.5 ± 0.3	1.2 ± 0.1
Sütyemez-2	396 ± 35	123 ± 12	239 ± 22	2.2 ± 0.2	1.9 ± 0.1	1.0 ± 0.1	0.6 ± 0.01	**6.0 ± 0.5**
Sütyemez-1	312 ± 30	121 ± 12	231 ± 23	2.3 ± 0.2	1.9 ± 0.1	1.0 ± 0.1	1.1 ± 0.1	2.7 ± 0.2
Maraş-8	322 ± 31	115 ± 11	307 ± 30	2.3 ± 0.2	2.5 ± 0.4	1.4 ± 0.1	0.7 ± 0.01	5.4 ± 0.5
Maraş-10	314 ± 30	**140 ± 13**	214 ± 21	**6.9 ± 0.5**	1.9 ± 0.3	1.6 ± 0.2	0.5 ± 0.01	**6.0 ± 0.5**
Maraş-19	388 ± 37	110 ± 11	281 ± 27	1.8 ± 0.1	1.9 ± 0.1	1.0 ± 0.1	0.4 ± 0.01	5.2 ± 0.5
Bursa-95	**419 ± 40**	**142 ± 13**	251 ± 25	2.9 ± 0.2	1.2 ± 0.1	0.5 ± 0.01	0.6 ± 0.01	2.4 ± 0.2

Sahin[6] also determined the mineral composition of native walnut types. The amount of minerals (mg/100g) reached 1.8–2.9 for iron, 1.1–1.5 for copper, 1.1–4.3 for manganese, 1.2–1.9 for zinc, 129–202 for magnesium, 258–487 for potassium. In another study, mineral composition of walnut was determined as follows (mg/g): K: 277–416; Mg: 102.87–142.18; Ca: 202.61–414.39; Fe: 1.171–69.22; Zn: 1.157–38.43; Cu: 0.592–2.170; Na: 0.479–5.6; Mn: 1.233–7.498[7]. The mineral compositions of some Turkish walnut types were determined by Caglarirmak[8]. But in this study, investigated cultivars were not standard cv. In this study, average mineral contents (mg/100g) were determined as follows: K, 270; Ca, 85; Mg, 90; Zn; 2.0; Mn, 2.5; Cu, 101; Fe, 2.9.

Our data are in agreement with those of earlier reports shown in Table-2 and other literature. In our study, calcium content of investigated cultivars was found higher than formerly reported data. The differences in mineral content of walnut in Table-2 and other literature could result from walnut origin and different cultivars. Walnut cultivars and origin were not stated in these researches that are shown in Table-2.

TABLE-2
MINERAL AVERAGE LEVELS REPORTED IN THE LITERATURE FOR WALNUT CULTIVAR[a]

Author	Payne[11]	Randoin *et al.*[12]	Feinberg *et al.*[13]	Klepping *et al.*[14]	Ravai[15]	Souci *et al.*[16]	Anonymous[17]
Origin	California	California	—	—	—	California	—
Ca	90	80	61	87	89	60–100	108
Cu	1	1	—	—	1.3	0.3–1.4	0.9–3.2
Fe	2.6	2.1	—	2.5	2.4	2–3.1	2.1–7.6
K	423	600	690	544	391	440–700	328–606
Mg	137	132	130	129	113	92–144	132–137
Mn	1.7	—	—	—	2.1	0.75–3.21	2.4–2.7
Na	15.4	3	3	2.4	10	1–4	2–17
Zn	2.7	2	—	—	2.9	2–3.2	—

[a]Values expressed as mg 100 g^{-1}

Hartley, Pedro and Chandler are the most commonly grown cultivars in California. Hartley contained higher content of calcium, zinc and copper than other walnut varieties in our study. However, the content of calcium, zinc, copper and manganese of Hartley grown in Turkey is higher than Hartley grown in France and California[9]. On the other hand, Na content of this cultivar is lower in Hartley grown in Turkey. The differences could result from origin and ecological conditions. For instance, mineral absorption of plants is greatly affected by elemental composition and pH of orchard soil[10]. Also, acidic soils enhance Cu and Mn absorption. Inversely, chalky soils have been shown to lower iron absorption.

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