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Trace Elements in Some Hazelnut Varieties Near Industrial Area and Far From Industrial Area in Turkey

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The aim of this work is to compare the Cu, Mn, Ni, Co, Fe, Zn contents of three native Turkish hazelnut varieties (Karayagli, Yomra and Delisava) near industrial area and far from industrial area. Trace element contents were determined by a flame and graphite furnace atomic absorption spectrometry technique after wet-digestion. The results according to this study showed that Mn and Co concentrations in the hazelnut in industrrial area and far from industrial area were generally correlated with the degree of trace element contamination of the environment. Other elements Cu, Ni, Fe and Zn were generally not correlated with the degree of trace element of the environment.

Key Words: Hazelnut, Trace element, Atomic absorption spectrometry, Wet digestion.

INTRODUCTION

Hazelnut (*Corylus avellana* L.) belongs to the Betulaceae family and is a popular tree nut worldwide, mainly distributed in the coasts of the Black Sea region of Turkey, the Southern Europe (Italy, Spain, Portugal, France and Greece) and in some areas of the US (Oregon and Washington). The hazelnut can also be cultivated in some other countries such as New Zealand, China, Azerbaijan, Chile, Iran and Georgia. Turkey is the world's largest producer of hazelnuts, contributing *ca.* 74 % to the total global production[1]. The major shelled hazelnut exporters are Turkey, Italy, Azerbaijan and Georgia, which supply 67, 12, 4.5 and 2.5 % of the world hazelnut export, respectively[2]. Hazelnut plays a major role in human nutrition and health, due to its fatty acid profiles, protein, carbohydrates, vitamins, minerals, fibre, sterols, tocols, squalene, antioxidants, phenolic compounds and phytochemicals[3-8]. Several research groups have reported the benefits of inclusion of hazelnut into human diet. This is mainly related to its fat components (around 60-65 %), most of which are highly rich in monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), tocopherols, phytosterols, polyphenols, squalene, minor components and phytochemicals[9-11].

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Trace elements are essential for healty human development and maintenance at low doses but may also be toxic for humans, animals and plants at higher doses[12,13]. Several works have been published in recent years on the biological functions of microelements in humans. Nickel is thought to play an important role in Ca and Zn metabolism and absorption of Fe. It is also a component or cofactor of several enzymes such as urease, hydrogenase, dehyrogenase and transaminase[14]. Copper and zinc are required in the human diet because they exhibit a wide range of biological functions as components of redox and enzymatic systems[15]. Cobalt and iron are components of vitamin B_{12} and heme containing proteins, respectively. Cobalt or iron deficiency causes microcytic hypochromic anemia in man. Therefore, in recent years, there has been an increasing interest in the use of trace elements as micronutrient supplements in medical treatment to prevent various diseases such as cancers, cardiovascular, Aids, Alzheimer's disease, Kashin-Beck disease, Keshan disease, osteoporosis, osteoarthritis, asthma, goiter, cataracts, stroke, arthritis, ageing, anemia and so on and to complete mineral deficiency[12,16-18]. However, many conscious people prefer consuming rich foods with microelements to consuming supplements. In particular, hazelnut is known to be a concentrated food for major elements and it may become an interesting food for its trace elements for the human diet.

The objective of this research was to compare the Cu, Mn, Ni, Co, Fe, Zn contents of three native Turkish hazelnut varieties (Karayagli, Yomra and Delisava) near industrial area and far from industrial area.

EXPERIMENTAL

For the elemental analysis, a Perkin-Elmer analyst 700 atomic absorption spectrometer with deuterium background was used in this study.

All reagents were of analytical reagent grade unless otherwise stated. Double deionized water was used for all dilutions. Nitric acid and hydrogen peroxide were of suprapure quality (Merck, Darmstadt, Germany). Standard working solutions were prepared from stock solution (1000 mg/L, Merck) before use. Deionized water was used (Milli-Q system, Millipore, USA). All glasswares were soaked in nitric acid 10 % for 0.5 h and rinsed with deionized water before use.

Samples: Three native Turkish hazelnut varieties (Karayagli, Yomra and Delisava) were obtained in Sakarya province, Turkey.

Procedure: For digestion with wet ashing, 1.0 g from real samples was used. Wet digestion of samples was performed by using mixtures of acids, namely, HNO_3-H_2O_2 (6:2), 16 mL of each mixture was used for a 1.0 g sample. Each mixture was heated up to 130 ºC for 4 h on the hot plate. Then, acid mixtures were added again. After cooling, 5 mL of distilled water was added to the sample and mixed. The residue was filtered through blue band filter paper. Then the sample was diluted to 10 mL with distilled water. The blank digestions were also carried out in the same way.

Detection limit is defined as the concentration corresponding to three times the standard deviation of ten blanks. Detection limit values of elements (as mg/kg) in flame AAS were 0.009 for Zn and 0.005 for Fe. However, Co Cu, Ni and Mn were below this detection limit of the flame AAS. These elements were determined using graphite furnace AAS. During the analyses, internal argon flow rate through the graphite tube was 250 mL min^{-1}; gas flow was interrupted during atomization. Sample volume, ramp and hold times for the drying, ashing, atomization and cleaning temperatures were optimized before analysis to obtain maximum absorbance and minimum background. Elements were quantified on the basis of peak areas and comparison with a calibration curve obtained with corresponding standards.

Statistical analysis: All data analyses were performed in triplicate. The data were recorded as mean ± standard eror and analysed by SPSS (version 9.0 for Windows 98, SPSS Inc.). One-way analysis of variance was performed by ANOVA procedures. Significant differences between means were determined by Duncan's Multiple Range tests. p values < 0.05 were regarded as significant and p values < 0.01 very signicant.

RESULTS AND DISCUSSION

With increasing environmental pollution a heavy metal exposure assessment study is necessary[12,19]. The heavy metals enter the human body through inhalation and ingestion. The intake *via* ingestion depends upon food habits. The metals, Cu and Zn, are essential micro nutrients and have a variety of biochemical functions in all living organisms but they can be toxic when taken in excess.

In this study, the highest copper content was 12.4 mg/kg, for the species Yomra in industrial area group, whereas the lowest copper content was 10.5 mg/kg, for the species Karayagli in control group (Table-1). Copper contents ranged from 10.5-12.4 mg/kg in both control and industrial area group. This differences were not significant as statistical not only species but also groups ($p > 0.05$). Copper contents in vegetables should be considered as a nutritional source of the element. Nevertheless, for people, bioavailability from plant origin source was reported to be low, due to limited absorption from the small intestine[3,4].

TABLE-1
ELEMENT CONTENT (mg/kg) OF THREE HAZELNUT VARIETIES FEOM FAR INDUSTRIAL AREA AND INDUSTRIAL AREA IN SAKARYA, TURKEY

Native hazelnut name		Cu	Mn	Ni	Co	Fe	Zn
Karayagli	Far from industrial area	10.51^{a}	32.20^{b}	1.66^{a}	1.89^{b}	46.74^{a}	11.38^{a}
	Industraial area	12.05^{a}	15.88^{c}	1.66^{a}	1.89^{b}	44.78^{a}	11.30^{a}
Yomra	Far from industrial area	11.15^{a}	14.85^{c}	2.40^{a}	1.72^{b}	46.96^{a}	10.44^{a}
	Industraial area	12.43^{a}	17.79^{c}	2.03^{a}	$2.58^{a,b}$	45.43^{a}	10.24^{a}
Delisava	Far from industrial area	10.64^{a}	38.08^{ab}	2.77^{a}	3.45^{a}	45.43^{a}	12.45^{a}
	Industraial area	11.54^{a}	38.53^{a}	2.77^{a}	$2.76^{a,b}$	45.43^{a}	12.77^{a}
	SEM	0.30	3.14	0.17	0.21	0.32	0.38
	p	> 0.05	< 0.01	> 0.05	< 0.05	> 0.05	> 0.05

Data are expressed as means ± SE (n = 3) on a dry weight basis. Values within a column with different superscript uppercase letters differ significantly.

Minimum and maximum values of manganese in the present study were 14.9 and 38.5 mg/kg. The highest manganese content was seen in Delisava and the lowest in Yomra (Table-1). According to the statistical analysis there is significant difference in those groups ($p < 0.01$). Manganese activates same enzymes in the living body. Foods contain relatively small amounts of manganese. The average manganese level in hazelnut was given as 36.5 mg/kg by Kargosha and Noroozifar[20]. Manganese content in the present work were agreement some previous studies[20] and disagreement with some studies[21].

The nickel level in hazelnut samples varied from 1.7-2.8 mg/kg (Table-1). We observed the highest amount of Ni in Delisava (2.8 mg/kg). Present data are in agreement with values given in the literature[19].

In this study the Co level ranged from 1.7-2.6 mg/kg (Table-1). Cobalt contents in present study is higher than the previous study[22]. According to the statistical analysis there is no significant difference in Karayagli (1.89 mg/kg) and Yomra (2.15 mg/kg) groups ($p > 0.05$). But Co content in Delisava higher than Karayagli and Yomra and there is significant difference between the groups ($p < 0.05$).

The highest iron content was 47.0 mg/kg in Yomra species at industry area whereas the lowest iron content was 44.8 mg/kg in Karayagli species (Table-1). According to the statistical analysis there is no significant difference in hazelnut species and industrial area or far industrial area. Iron contents in hazelnut of the present study is in agreement with the previous studies[22].

Minimum and maximum values of zinc in the present study were 10.3 and 12.8 mg/kg. The highest and lowest levels were found in Delisava species (Table-1). Zinc content in the present study is not agreement with results of Simsek and Aykurt[22]. But zinc level of this study was in conformity with the results of Demirel *et al.*[23]. Zinc value of this study lower than the some previous studies and agreement of some previous studies.

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