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Mineral Contents of Two Wild Morels

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İki Yabani Kuzu Göbeğinin Mineral İçerikleri

Abstract: Mineral (Ni, Cu, Co, Zn, Cr, Mn, Mg, Cd, Fe, Ca and Pb) contents of two wild edible morels, *Morchella deliciosa* Fr. and *Morchella elata* Fr., which are collected and consumed in Gaziantep province, were determined by an atomic absorption spectrophotometer (AAS). Although both of the morelscontained considerable amounts of minerals, all the contents are in the range reported from Turkey.

Key words: Mineral content, mushrooms, Gaziantep, Turkey

Özet: Gaziantep yöresinde toplanıp tüketilmekte olan İki yabani yenilebilir kuzu göbeği türünün, Morchella deliciosa Fr. and Morchella elata Fr., mineral (Ni, Cu, Co, Zn, Cr, Mn, Mg, Cd, Fe, Ca ve Pb) içerikleri atomik absorpsiyon spectrofotometresi kullanılarak belirlenmiştir. Her iki kuzu göbeği de kayda değer mineral içeriğine sahip olmasına rağmen, bütün içeriklerTürkiye'den rapor edilen aralıktadır.

Anahtar Kelimeler: Mineral içerik, mantarlar, Gaziantep, Turkey

1. Introduction

Fungi are an important group of organisms in nature and can be found almost everywhere in terrestrial ecosystems. Some of them with relatively large fruting bodies and varying degrees of edibility are known as mushrooms and have long been used as a source food for human in various cultures. Mushrooms are usually considered as valuable nutrient sources and many of them are also recommended against health problems such as headache, colds, asthma, diabetes etc. (Kalač et al., 1991).

Fruiting bodies of mushrooms are generally known to be rich in mineral contents (Vetter, 1990), because of the environmental factors such as amount of organic matter, pH and metal concentrations of underlying soil (Garcia et al., 1998). Due to such properties, mushrooms are thought to be used to evaluate the level of environmental pollution (Sesli and Tüzen, 1999).

Minerals such as iron, copper, zinc and manganese are essential metals and play important roles in living systems (Tüzen et al., 2007), but they may be hazardous on human if they are taken above threshold concentrations (Olumuyiwa et al., 2007).

Many studies have been carried out ot the metal contents of wild growing mushrooms in many countries. Kalač (2009) published a review about the contents of generally studies elements in fruit bodied of mushrooms. Similar studies were also carried out to determined the mineral contents of naturally growing mushrooms, collected from different regions of Turkey (Işıldak et al., 2004; Türkekul et al., 2004; Sesli et al., 2008; Gençcelep et al., 2009; Uzun et al., 2011; Kaya and Bağ, 2013; Tel et al., 2014; Kaya et al., 2017).

This work aims to determine the mineral contents of the fruiting bodies of two wild morels, *Morchella deliciosa* Fr. and *Morchella elata* Fr.

2. Materials and Method

Dry fruit bodies of *Morchella deliciosa* and *Morchella elata* (Fig. 1) were obtained from the findings of TOVAG-212T112 which were carried out within the boundaries of Gaziantep province (Turkey). The habitats of the collected samples generally were pine forest, pine-oak mixed forest or pine-fir-cedar mixed forest.

Mushroom samples were prepared for element analysis by following the procedure followed by Khairiah et al. (2004) and Kaçar (1984). First of all the samples were washed with ultrapure water and dried at 80 °C for 8-10 hours. Then the samples were crushed and dried again at same temperature. One g of powdered mushroom samples were put in 50 ml beakers and 15 ml of HNO_3 were added. After waiting 8-10 hours, 4 ml $HCIO_4$ were added and heated gently for about 5-6 hours and cooled. Then 5 ml of H_2O_2 was added and heated till the solution is colorless enough. The solution was cooled and distilled water was added on it until the total volume reaches to 10 ml.

Figure 1. Fruit bodies of *M. deliciosa*(a) *and M. elata* (b)

Element analysis of mushroom samples were performed by using flame atomic absorbtion spectrophotometer (FAAS). The absorption measurements of the elements

were performed under the conditions recommended by the manufacturer and metal ion concentrations were determined as six replicates.

3. Results

The metal concentrations were determined on dry weight basis. Except Pb, all the minerals were in detectable limits in fruit bodies of both mushrooms. Lead was detected only in *Morchella deliciosa.* The average contents of trace elements in *Morchella deliciosa* samples were 5,05, 14,17, 2,47, 100,1, 0,408, 22,24, 61,09, 1,713, 120, 2036 and 13,69 mg/kg for Ni, Cu, Co, Zn, Cr, Mn, Mg, Cd, Fe, Ca and Pb respectively. The amount of the same minerals within the same order in *Morhella elata* were 9,063, 18,74, 3,353, 95,23, 5,468, 55,54, 61,97, 2,788, 433,6, 1997 and ND. Measured and average concentrations (mg/kg, dry weight basis) of heavy metals in two morels were given in Table 1 and Table 2.

Table 1. Measured and average concentrations of heavy metals in *Morchella elata*

	Ni	Cu	Co	Zn	Cr	Mn	Mg	Cd	Fe	Ca	Pb
Morchella elata	8,835	19,02	3,03	95,49	6,21	51,99	61,61	2,655	440	1976	…
	8,835	19,82	3,18	92,51	5,97	60,06	61,8	2,67	443,7	2120	…
	8,94	19,61	3,81	94,89	6,27	60,11	61,89	2,775	443,6	2133	…
	9,255	18,78	3,405	101	4,695	49,2	62,13	2,865	426,5	1832	…
	9,315	17,6	3,48	94,94	4,905	55,61	62,16	2,82	423,9	1931	…
	9,195	17,61	3,21	92,58	4,755	56,25	62,21	2,94	424,1	1994	…
Mean	9,063	18,74	3,353	95,23	5,468	55,54	61,97	2,788	433,6	1997	…
± SD	±0.218	±0.956	±0.277	±3.080	±0.757	±4.349	±0.239	±0.111	±9.775	±114.7	

Table 2. Measured and average concentrations of heavy metals in *Morchella deliciosa*

	Ni	Cu	Co	Zn	Cr	Mn	Mg	Cd	Fe	Ca	Pb
Morchella deliciosa	4,875	14,64	2,43	101	0,18	22,56	61,19	1,695	120,2	2217	13,16
	4,785	16,37	2,73	104,4	0,54	24,81	61,14	1,65	120,1	2331	13,5
	5,61	16,64	2,595	104,8	0,405	24,98	61,19	1,74	120,3	2267	15,05
	5,085	12,24	2,25	95,34	0,555	19,31	60,96	1,83	116,7	1761	13,73
	5,025	12,41	2,37	97,14	0,405	20,81	61,01	1,785	121,4	1787	13,91
	4,92	12,72	2,445	97,95	0,36	20,96	61,04	1,575	121,6	1851	12,78
Mean	5,05	14,17	2,47	100,1	0,408	22,24	61,09	1,713	120	2036	13,69
± SD	±0.294	±2.003	±0.170	±3.935	±0.137	±2.303	±0.098	±0.093	±1.757	±262.7	±0.779

4. Discussions

Minerals play a vital role in the proper development and health of human body. However, high amounts of certain minerals are also toxic for most organisms (Savas et al., 1995).

In the presented study, although lead was not detected in *Morchella elata*, it was measured as 13.69 mg/kg in *Morchella deliciosa*. The reported Pb values for mushrooms were 0.5–20 mg/kg (Kalač et al., 2001). Common Pb content in many mushroom species from unpolluted sites is below 2 mg/kg, but levels up to 5 mg/kg have been reported for numerous species. Increased levels are common in mushrooms growing around highways. Extremely high Pb levels over 100 mg/kg were observed in the close vicinity of lead smelters (Kalač et al., 2004).

Nickel content ranged from 4.785 (*Morchella deliciosa*) to 9.315 (*Morchella elata*) mg/kg. The reported Ni values for wild-growing mushrooms were 44.6–127, 0.4–15.9, 2.73–19.4, 0.4–2, 8.2–26.7, 1.72–24.1, 44.6–127 mg/kg (Demirbaş, 2001a; Işıldak et al., 2004; Işıloğlu et al., 2001; Kalač et al., 2001; Mendil et al., 2004; Soylak et al., 2005), respectively. Hence, in this study, Ni levels are in agreement with previous studies.

Cadmium levels in morels ranged from 1.575 (*Morchella deliciosa*) to 2.940 (*Morchella elata*) mg/kg. An extremely high content up to 300 mg/kg is reported in the literature (Seeger, 1982). Considerably increased Cd levels were reported in mushrooms growing in the vicinity of metal smelters (Kalač et al., 1996; Svoboda et al., 2000) and within a town (Kalač et al., 2003). It was reported that cadmium is accumulated mainly in kidneys, spleen and liver and its blood serum level increases considerably following mushroom consumption (Kalač et al., 2001). Thus, Cd seems to be the most deleterious among heavy metals in mushrooms (Kalač et al., 2004).

The range of iron concentrations were between 116.7 (*Morchella deliciosa*) and 443.7 (*Morchella elata*) mg/kg in mushroom species. Fe values in mushrooms samples have been reported in the range of 31.3–1190 mg/kg (Kojo et al., 1989), 568–3904 mg/kg (Turkekul et al., 2004), 102–1580 mg/kg (Soylak et al., 2005), 50–842 mg/kg (Gençcelep et al., 2009), and 38.9–499.0 mg/kg (Ouzouni et al., 2009). Observed Fe values are in agreement with those reported in the literature.

The measured manganese content was 19.31 mg/kg in *Morchella deliciosa*, whereas it was 60.11 mg/kg in *Morchella elata*. The reported Mn contents in previous studies for wild-growing mushrooms were 12.9–93.3 mg/kg (Kalač et al., 2000), 5.0–60.0 mg/kg (Tuzen, 2003), 14.5–63.6 mg/kg (Işıldak et al., 2004), 5.5–135 mg/kg (Gençcelep et al., 2009), 7.6–56.2 mg/kg (Demirbaş, 2001b) and 14.5–63.6 mg/kg (Işıloğlu et al., 2001). In this study, Mn levels are in agreement with previous studies. Mn is essential for most physiological functions such as bone and cartilage formation, amino acid, glucose and

cholesterol metabolisms and Mn-mediated anti-oxidant enzymes (NAS, 2001).

Zinc has a biological significance for living organisms and mushrooms are known as good zinc accumulators (Işıloğlu et al, 2001). Zn content measured as 92.51mg/kg for *Morchella elata* and 104.8 mg/kg for *Morchella deliciosa*. Content of Zn in mushrooms ranges from 30 to 150 mg/kg (Kalač et al., 2000), 21 to 100 mg/kg (Çayır et al., 2010), and 35 to 136 mg/kg (Radulescu et al., 2010).

Copper were measured (in average) as 12.24 and 19.82 mg/kg in *Morchella deliciosa* and *Morchella elata*, respectively. Kalač and Svoboda (2000) reported that Cu levels in the accumulating species are usually 100–300 mg/kg, which is not considered a health risk. The Cu results of all mushroom species were in agreement with those found in the literature (Chen et al., 2009; Işıldak et al., 2004; Kalač et al., 1996; Svoboda et al., 2000).

Average cobalt contents for two morels were 2.250 and 3.810 mg/kg. The amount of Co was determined as 7.42 mg/kg for *Agrocybe dura* (Kaya et al., 2010), 7.2 mg/kg for Ramaria largentii (Ouzuni et al., 2009) and 5.8 mg/kg for *Agaricus arvensis* (Borovička et al., 2007). The determined Co contents are in agreement with the previous studies.

The determined chromium concentration was 6.27 mg/kg in *Morchella elata*. The Cr concentration was 0.18 mg/kg in *Morchella deliciosa*. Tüzen (2003) reported Cr content as 0.87- 2.66 mg/kg, Sivrikaya et al. (2002) as 7.0-11.0 mg/kg and Kaya et al. (2011) as 0.77-80.03 mg/kg. Because of its ability to increase glucose tolerance in type-II diabetes mellitus patients (Anderson, 2000), Cr is considered essential to man. The recommended dietary intake for chromium is 0.035 mg/day for male and 0.025 mg/day for the female (Anonymous, 2001). Mushrooms could be thought as a potential source of this element.

Minimum and maximum values of magnesium were 60.96 and 62.21 mg/kg. The highest and lowest levels of Mg were found in *Morchella deliciosa* and *Morchella elata*. Demirbaş (2001a) reported the content of this mineral as 330 mg/kg in *Tricholoma anatolicum* and 6560 mg/kg in *Morchella deliciosa*. Turkekul et al. (2004), Sesli et al. (2008) also reported the Mg content within the range of 688 mg/kg and 1150 mg/kg. Compared to earlier published reports the determined levels of Mg is relatively low.

Calcium content ranged from 1761 (*Morchella deliciosa*) to 2331 (*Morchella deliciosa*) mg/kg. Compared to reports of Kalač, (2009) (100-2400 mg/kg) and Sanmeea et al. (2003) (100-2400 mg/kg). The determined Ca contents are in agreement with the previous studies. Gençcelep et al. (2009) reported the Ca content to be 8800 mg/kg for *Lepista nuda*. Compared to earlier published reports the determined levels of Ca is relatively low. Unlike Ca levels in this study are in agreement with the higher value reported in the literature (Lee et al., 2009) (159.8-324.3 mg/kg).

The essential element concentrations (Mn, Fe, Cu, Zn, Ni) in the two morels were determined to be at suitable levels. Kalac et al. (1991) reported that heavy metals such as lead, cadmium and chromium can accumulate in the body and may be harmful for humans after chronic consumption.

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