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# Analysis of Trace Metal Levels in Wild Mushrooms

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Three macro elements and nine trace elements contents of 30 wild edible mushrooms collected from Kahramanmaras province of Turkey, were analyzed. The minimum and maximum heavy metal amounts of mushrooms were analyzed as mg/g dry weight for Ca (0.072-8.32), Mg (0.33-6.56), K (8.11-28.15) and as mg/kg for Fe (65.56-7156), Zn (13.18-230.85), Cu (4.30-84.67), Cr (0.77-80.03), Mn (5.15-91.21), Pb (not detected-3.10), Ni (0.79-174.15), Cd (0.00-8.67) and Co (0.00-10.92). The potassium content was found to be higher than those of the other minerals in all mushrooms, studied and *Morchella deliciosa* was found to have the highest Fe, Cr, Mn, Pb, Ni and Co concentrations among the analyzed species.

**Key Words: Wild edible mushrooms, Minerals, Toxic elemenets, Trace metal.**

## INTRODUCTION

Numerous species of wild-growing mushrooms are widely consumed as a delicacy in central and Eastern Europe and Far East. Though the consumption of wild edible mushrooms is increasing, even in the developed world, due to their good contents of proteins and trace minerals[1], the evaluation of their nutritional value has so far been limited due to the fragmentary knowledge of their composition and the limited information on the availability of their constituents[2].

It is known that, wild-growing mushrooms may accumulate great concentrations of toxic metallic elements such as mercury, cadmium, lead, copper or arsenic, metalloids and radionuclides[3-9]. Many reports, concerning the ability of wild-growing mushrooms to take up and accumulate metals, were presented from several countries such as France[10], Czech Republic[11], Poland[8,12,13], Slovakia[8,14], Spain[15], Turkey[16-19] and USA[20].

The accumulation of metals in macrofungi has been found to be affected by environmental and fungal factors[15]. Amount of organic matter, pH, metal concentrations in soil are among the environmental factors. Species of fungi, morphological part of fruit body, development stage and age of mycelium, biochemical composition and fructification intervals can be listed as fungal factors influencing the mineral accumulation[15-17,19,21].

Turkey has a very rich edible macrofungal flora, due to its favourable environmental conditions and is an important exporter of wild edible mushrooms. Mushrooms are also collected to make a substantial contribution to food intake. Therefore, it is necessary to know the levels of essential elements in edible mushrooms[22].

Trace elements, whether essential or non-essential, above threshold concentration levels, can cause morphological abnormalities, reduce growth and increase mortality and mutagenic effects in humans[23]. Metals, such as iron, copper, zinc and manganese are essential metals, since they play important role in biological systems. Lead and cadmium are non-essential metals as they are toxic, even in traces. The essential metals could also produce toxic effects when the metal intake is excessively elevated[24]. The average intakes are 1000, 2, 18, 400, 2, 1000 and 15 mg/day for Ca, Cu, Fe, Mg, Mn, K and Zn for USA, respectively. This daily nutrient intake is likely to pose no risk of adverse effects[25].

The aim of this study is to determine toxic and essential elements (Fe, Mn, Zn, Cu, Ca, Mg, K, Cd, Co, Cr, Ni and Pb) in fruit bodies (pileus + stipe) of 30 edible mushroom species from Kahramanmaras, Turkey.

## EXPERIMENTAL

Wild edible mushroom were obtained from the macrofungi samples collected from Kahramanmaras province (Fig. 1) of Turkey[26]. Obtaining the macroscopic and microscopic taxonomic data by mycological techniques, the samples were identified with the help relevant literature[27-30]. Specimen are

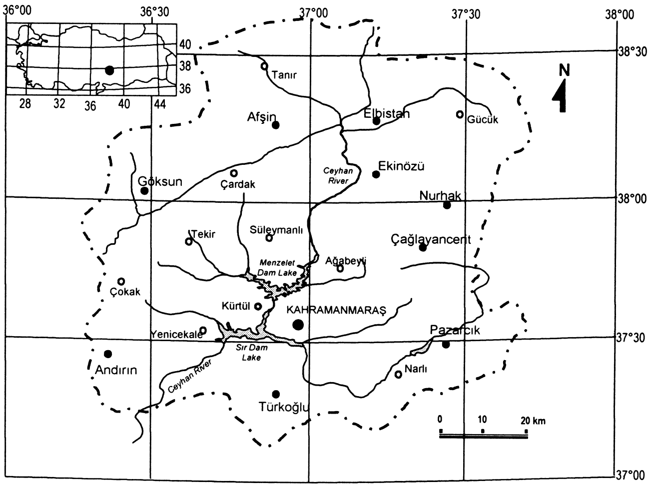

Fig. 1. Macrofungi collection area

kept in Fungarium of Faculty of Science, Karamanoglu Mehmetbey University. The habitat and localities of wild edible macrofungi taxa are given in Table-1.

TABLE-1
LOCALITIES AND HABITAT OF WILD EDIBLE MACROFUNGI COLLECTED FROM KAHRAMANMARAS PROVINCE OF TURKEY

| No. | Class, family and taxa of macrofungi | Locality and habitat |
|---|---|---|
| | Pezizomycetes | |
| | Morchellaceae Rchb. | |
| 1 | *Morchella deliciosa* Fr. | Baskonus mount, 37°34'N, 36°35'E, 1290 m, in conifer forest |
| 2 | *Morchella elata* Fr. | Andirin, Yesilova, 37°26'N, 36°17'E, 198 m, around wood stores |
| 3 | *Mitrophora semilibera* (DC.) Lév. | Tekir, 38°53'N, 36°37'E, 1017 m, under *Populus* sp. |
| | Agaricomycetes | |
| | Agaricaceae Chevall. | |
| 4 | *Coprinus comatus* (O.F. Müll.) Pers. | Göksun, Kizilcik, 38°09'N, 36°42'E, 1325 m, under poplar trees |
| 5 | *Leucoagaricus leucothites* (Vittad.) Wasser | Ilica, 37°50'N, 36°51'E, 819 m, meadow |
| 6 | *Lycoperdon molle* Pers. | Yenidemir, 37°38'N, 36°36'E, 490 m, in conifer forest |
| 7 | *Macrolepiota excoriata* (Schaeff.) M.M. Moser | Kapiçam, 37°29'N, 37°01'E, 610 m, in conifer forest |
| | Amanitaceae R. Heim ex Pouzar | |
| 8 | *Amanita ovoidea* (Bull.) Link | Andirin, Kizik, 37°24'N, 36°36'E, 496 m, in mixed forest |
| | Hygrophoraceae Lotsy | |
| 9 | *Hygrophorus chrysodon* (Batsch) Fr. | Baskonus mount, 37°33'N, 36°34'E, 1340 m, in mixed forest |
| | Lyophyllaceae Jülich | |
| 10 | *Calocybe gambosa* (Fr.) Donk | Göksun, Tahirbey, 38°08'N, 36°26'E, 1554 m, under poplar trees |
| | Physalacriaceae Corner | |
| 11 | *Armillaria mellea* (Vahl) P. Kumm. | Göksun, Kizilcik, 38°09'N, 36°42'E, 1315 m, on remains of poplar trees |
| | Pleurotaceae Kühner | |
| 12 | *Pleurotus dryinus* (Pers.) P. Kumm. | Göksun, Mehmetbey, 38°05'N, 36°28'E, 1395 m, on poplar tree |
| 13 | *Pleurotus ostreatus* (Jacq.) P. Kumm. | Tekir, 37°53'N, 36°37'E, 1017 m, on stumps of poplar tree |
| | Tricholomataceae R. Heim ex Pouzar | |
| 14 | *Clitocybe alexandrii* (Gillet) Konrad | Yenidemir-Süllüler, 37°38'N, 36°38'E, 497 m, in conifer forest |
| 15 | *Leucopaxillus gentianeus* (Quél.) Kotl. | Baskonus mount, 37°34'N, 36°34'E, 1273 m, in conifer forest |
| 16 | *Melanoleuca cognata* var. *cognata* (Fr.) Konrad and Maubl. | Göksun, Sogukpinar, 38°03'N, 36°24'E, 1768 m, in conifer forest |
| 17 | *Tricholoma anatolicum* Dogan and Intini | Göksun, Sogukpinar, 38°03'N, 36°25'E, 1680 m, in fir forest |
| 18 | *Tricholoma fracticum* (Britzelm.) Kreisel | Baskonus mount, 37°34'N, 36°35'E, 1235 m, in conifer forest |
| 19 | *Tricholoma myomyces* (Pers.) J.E. Lange | Türkoglu, Kizilenis, 37°21'N, 36°49'E, 465 m, in conifer forest |
| 20 | *Tricholoma populinum* J.E. Lange | Göksun, Tasoluk II, 37°56'N, 36°26'E, 1362 m, under poplar trees |
| | Boletales | |
| | Rhizopogonaceae Gäum. & C.W. Dodge | |
| 21 | *Rhizopogon luteolus* Fr. and Nordholm | Ilica, 37°50'N, 36°51'E, 819 m, in mixed forest |
| | Suillaceae Besl and Bresinsky | |
| 22 | *Suillus luteus* (L.) Roussel | Ilica, 37°50'N, 36°51'E, 808 m, in conifer forest |
| | Gomphales | |
| | Gomphaceae Donk | |
| 23 | *Gomphus clavatus* (Pers.) Gray | Besenli, 37°39'N, 37°14'E, 1330 m in conifer forest |
| 24 | *Ramaria flava* (Schaeff.) Quél. | Baskonus mount, 37°34'N, 36°34'E, 1322 m, in conifer forest |
| | Gomphidiaceae Maire ex Jülich | |
| 25 | *Chroogomphus rutilus* (Schaeff.) O.K. Mill. | Pazarcik, around Kartalkaya dam, 37°28'N, 37°15'E, 750 m, in conifer forest |
| | Polyporales | |
| | Polyporaceae Fr. ex Corda | |
| 26 | *Lentinus tigrinus* (Bull.) Fr. | Tekir, 37°53'N, 36°37'E, 1018 m, on stumps of poplar trees |
| 27 | *Polyporus squamosus* (Huds.) Fr. | Ekinözü, Suçati, 37°35'N, 37°11'E, 947 m, on stumps of willow trees |
| | Russulales | |
| | Russulaceae Lotsy | |
| 28 | *Lactarius controversus* (Pers.) Pers. | Göksun, Gölpinar, 37°57'N, 36°29'E, 1370 m, under poplar trees |
| 29 | *Lactarius deliciosus* (L.) Gray | Yenidemir-Süllüler, 37°38'N, 36°38'E, 497 m, in conifer forest |
| 30 | *Russula delica* Fr. | Andirin, Akifiye, 37°42'N, 36°20'E, 1177 m, in mixed forest |

Atomic absorption spectrophotometer (Varian Techtron Model AAS 1000, Varian Associates, Palo Alto, CA) was used for the determination of the minerals (Fe, Cu, Zn, Mn, Mg, Ca, Pb, Cr, Ni, Cd, Co and K) in dried fruit bodies of macrofungi. The samples, which were digested in an acid solution of $HNO_3$, were passed through the AAS system using different lamps and calibrated with related minerals in different concentrations for different micronutrients[31]. The values of Mg, Ca and K were determined as mg/g dw, while the value of Zn, Fe, Cu, Mn, Pb, Cr, Cd, Co and Ni were calculated as mg/kg dw. Detection limit is defined as the concentration corresponding to three times the standard deviation of 10 blanks. Detection limit values of elements as mg/L in AAS were found to be

0.041 for Cu, 0.013 for Zn, 0.060 for Fe, 0.029 for Mn, 0.003 for Mg, 0.012 for K, 0.015 for Ca, 0.05 for Cr, 0.10 for Pb, 0.063 for Ni, 0.032 for Cd and 0.081 for Co. For all the mushroom species, three samples or more were analyzed.

## RESULTS AND DISCUSSION

Element concentrations of the mushroom species are presented in Table-2. According to the results, the most abundant elements was potassium, (ranging from 8.11-33.31 mg/g dw) and magnesium, respectively. These are followed by calcium. The most variable minerals were iron, zinc and copper, respectively. Lead was the lowest element (ranged between 0.00 and 3.10 mg/kg). Compared to manganese, the amount of chromium was much lower. It was ranged between 0.77 and 80.03 mg/g among the mushroom species studied.

Calcium concentrations ranged from 0.072 (*Pleurotus dryinus*) to 8.32 (*Mitrophora semilibera*) mg/g dw. The concentration levels of calcium in mushrooms are in agreement with previous studies[32]. But, it seems to be higher when compared to the concentrations obtained by Sanmeea *et al.*[33], (0.1-2.4 mg/g dw).

Magnesium content was 0.33 mg/g dw in *Tricholoma anatolicum* and 6.56 mg/g dw in *Morchella deliciosa* which is relatively high compared to earlier data[16]. Sanmeea *et al.*[33] reported that mature *Astraeus hygrometricus* had the highest concentrations of magnesium (1.6 mg/g).

Potassium content was found to be higher than other minerals in all mushrooms, varying between 8.11 (*Tricholoma anatolicum*) and 28.15 mg/g dw (*Leucoagaricus leucothites*). Gençcelep *et al.*[32] reported the potassium contents of wild edible mushrooms as being between 12.6 and 29.1 mg/g dw. Sanmeea *et al.*[33] reported that potassium accumulation in mushrooms could raise up to 45.2 mg/g. The overall data indicates that mushrooms may contain elevated levels of potassium.

Generally, the iron values in the present study are in agreement with reported literature values, except *Morchella deliciosa* (7156 mg/kg dw) having a relatively high content of Fe compared to previously recorded data. Iron values in mushroom samples (as reported) ranged from 31.3-1190 mg/kg[34], 568-3904 mg/kg[34], 56.1-7162 mg/kg[22], 102-1580 mg/kg[22], 30-150 mg/kg[21], 50.1-842.0 mg/kg[32], respectively. It is known that adequate iron in a diet is very important in order to decrease the incidence of anemia.

The zinc content was the lowest (13.18 mg/kg dw) in *Rhizopogon luteolus*, whereas it was the highest (230.85 mg/

TABLE-2
CONTENT OF ELEMENTS OF WILD EDIBLE MUSHROOMS

| No. | Amount of elements (mg/g dry weight) | | | Amount of elements (mg/kg dry weight) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ca | Mg | K | Fe | Zn | Cu | Cr | Mn | Pb | Ni | Cd | Co |
| 1 | 4.230 | 6.56 | 23.39 | 7156 | 16.28 | 14.72 | 80.03 | 91.21 | 3.10 | 174.15 | 2.530 | 10.920 |
| 2 | 5.290 | 2.99 | 19.37 | 571.61 | 108.39 | 18.32 | 5.67 | 28.27 | nd | 20.01 | 0.540 | 0.345 |
| 3 | 8.320 | 1.55 | 22.16 | 385.85 | 165.81 | 31.13 | 2.51 | 39.96 | nd | 3.77 | 8.670 | nd |
| 4 | 0.410 | 1.34 | 21.43 | 331.92 | 214.26 | 27.23 | 0.98 | 9.35 | nd | 3.08 | 0.670 | 0.174 |
| 5 | 0.820 | 1.53 | 28.15 | 180.05 | 69.82 | 25.55 | 0.91 | 6.30 | nd | 7.32 | 2.570 | nd |
| 6 | 0.480 | 2.67 | 20.57 | 1845.22 | 190.86 | 32.84 | 8.44 | 86.50 | nd | 9.83 | 2.040 | 0.984 |
| 7 | 0.240 | 1.86 | 22.92 | 107.58 | 62.93 | 84.67 | 2.31 | 15.74 | nd | 15.87 | 0.350 | 0.979 |
| 8 | 0.560 | 0.98 | 18.76 | 185.80 | 53.82 | 20.51 | 1.79 | 7.73 | nd | 6.84 | 0.980 | nd |
| 9 | 0.380 | 0.76 | 23.49 | 77.88 | 71.45 | 21.07 | 0.11 | 7.76 | nd | 2.66 | 0.810 | nd |
| 10 | 0.620 | 0.62 | 13.43 | 146.28 | 47.28 | 16.70 | 0.18 | 11.18 | nd | 1.58 | 0.910 | nd |
| 11 | 0.360 | 1.16 | 20.33 | 95.16 | 36.71 | 17.33 | 14.44 | 14.35 | nd | 0.79 | 1.750 | nd |
| 12 | 0.072 | 1.28 | 22.54 | 69.88 | 20.31 | 8.01 | 3.45 | 9.18 | nd | 2.23 | 1.620 | nd |
| 13 | 0.390 | 1.27 | 11.98 | 196.71 | 53.52 | 4.30 | 0.19 | 12.22 | nd | 5.84 | 2.940 | 0.201 |
| 14 | 0.540 | 1.10 | 18.20 | 89.12 | 47.99 | 36.35 | 0.17 | 22.76 | 0.59 | 1.25 | 1.097 | nd |
| 15 | 1.350 | 1.31 | 24.85 | 366.12 | 52.09 | 20.01 | 2.20 | 27.85 | nd | 11.70 | 0.190 | nd |
| 16 | 0.850 | 1.36 | 23.27 | 233.11 | 78.05 | 39.53 | 12.89 | 45.43 | nd | 1.21 | 1.047 | nd |
| 17 | 0.290 | 0.33 | 8.11 | 378.38 | 13.18 | 6.15 | 1.02 | 16.66 | nd | 2.89 | 0.099 | nd |
| 18 | 1.250 | 1.42 | 16.90 | 1840.88 | 30.48 | 5.64 | 6.64 | 50.10 | nd | 2.49 | 1.170 | 1.771 |
| 19 | 0.400 | 1.66 | 14.69 | 522.41 | 99.41 | 19.32 | 3.24 | 12.46 | nd | 19.30 | 1.120 | 0.721 |
| 20 | 0.800 | 0.90 | 13.05 | 1747.44 | 39.02 | 12.27 | 4.66 | 39.04 | 0.32 | 6.05 | 2.730 | 0.708 |
| 21 | 3.040 | 0.58 | 12.56 | 177.85 | 13.23 | 4.41 | 0.86 | 6.07 | nd | 2.57 | nd | nd |
| 22 | 0.510 | 1.17 | 20.72 | 188.48 | 122.51 | 28.70 | 1.38 | 6.99 | 0.92 | 2.31 | 0.060 | nd |
| 23 | 0.670 | 1.13 | 14.85 | 233.86 | 90.82 | 23.33 | 1.48 | 9.31 | nd | 3.56 | 0.500 | nd |
| 24 | 0.820 | 1.17 | 22.71 | 248.19 | 31.50 | 10.58 | 13.43 | 39.49 | 1.19 | 43.28 | 1.260 | 1.538 |
| 25 | 0.320 | 1.71 | 17.16 | 381.16 | 145.27 | 5.61 | 50.61 | 9.02 | nd | 17.38 | nd | nd |
| 26 | 1.740 | 1.30 | 13.05 | 113.04 | 37.15 | 12.08 | 0.83 | 13.06 | nd | 1.78 | 2.540 | 0.291 |
| 27 | 0.340 | 1.42 | 15.63 | 65.56 | 43.91 | 22.93 | 0.77 | 5.17 | nd | 1.24 | 3.370 | nd |
| 28 | 0.330 | 0.68 | 12.49 | 317.38 | 37.34 | 12.68 | 0.95 | 11.04 | nd | 2.55 | 1.000 | nd |
| 29 | 1.050 | 1.27 | 20.97 | 540.27 | 230.85 | 11.41 | 3.94 | 18.56 | nd | 13.37 | nd | nd |
| 30 | 0.330 | 0.51 | 11.15 | 279.43 | 230.23 | 39.06 | 2.31 | 13.27 | nd | 4.17 | 0.680 | 0.441 |
| Mean | 1.220 | 1.45 | 18.29 | 635.74 | 81.81 | 21.08 | 7.58 | 25.54 | 0.20 | 13.03 | 1.440 | 0.630 |
| Minimum | 0.072 | 0.33 | 8.11 | 65.56 | 13.18 | 4.30 | 0.77 | 5.17 | nd | 0.79 | nd | nd |
| Maximum | 8.320 | 6.56 | 28.15 | 7156 | 230.85 | 84.67 | 80.03 | 91.21 | 3.10 | 174.15 | 8.670 | 10.920 |

nd: Not detected.

kg dw) in *Lactarius deliciosus*. The reported literature zinc content ranged between 22.10 and 185 mg/kg dw[32-37]. Mushrooms are known as good zinc accumulators[22].

Minimum and maximum values of copper were 4.30 and 84.67 mg/kg dw in *Pleurotus ostreatus* and *Macrolepiota excoriata*, respectively. Copper contents of mushroom samples in the literature have been reported in the range of 4.71-51.0 mg/kg[38], 10.3-145 mg/kg[34] and 9.23-107 mg/kg dw[32], respectively. Copper contents found in this study are parallel to those reported in the literature. In mushrooms, copper concentrations below the range of 100-300 mg/kg dw, are considered not to have a health risk[21]. Nevertheless, for people, bioavailability of copper in mushrooms was reported to be low, due to the limited absorption from the small intestine[39].

Chromium was determined in all mushrooms in this study. The highest chromium content was observed in *Morchella deliciosa* (80.03 mg/kg dw) whereas it was the lowest in *Polyporus squamosus* (0.77 mg/kg dw). Though the chromium content is generally low in mushrooms studied, remarkably high concentrations were determined in *Morchella deliciosa* and *Chroogomphus rutilus*, compared to literature[16,21,40,41]. Chromium, unlike the other elements analyzed, is considered essential to man because of its ability to increase glucose tolerance in type-2 diabetes mellitus patients[42]. The recommended dietary intake for chromium is 0.035 mg/day for male and 0.025 mg/day for the female[25]. Mushrooms are a potential source of this element.

Like chromium, manganese was also determined in all mushrooms, studied and ranged from 5.17 mg/kg dw in *Polyporus squamosus* to 91.21 mg/kg dw in *Morchella deliciosa*. The reported manganese values in the literature for mushrooms were 21.7- 74.3 mg/kg, 7.1-81.3 mg/kg[36,43] and 5.54-135 mg/kg dw[32]. Except *Morchella deliciosa*, obtained manganese values are in agreement with those presented before.

Lead was determined only in five of 30 mushrooms. Lead concentrations of mushroom samples were generally low, except *Morchella deliciosa* with an amount of 3.10 mg/kg dw. Lead levels of all other samples were not higher compared to the reported lead values for mushrooms by Tüzen *et al.*[38] (2.35 mg/kg), Kalac and Svoboda[21] (0.5-20 mg/kg) and Kaya and Bag[37] (2.166 mg/kg). Lead has been reported to cause irreversible damage to the central nervous system and permanent mental retardation[44]. The acceptable daily intake of lead for adults is 0.21-0.25 mg $day^{-1}$ [45]. This shows that too much consumption of *Morchella deliciosa*, collected from this habitat, could lead to Pb body burden.

As it is the case for most of the minerals investigated in this study, *Morchella deliciosa* contained the highest nickel content with an amount of 174.15 mg/kg dry matter. Nickel levels ranged between 0.79-43.28 mg/kg for the other mushrooms species, studied. The reported nickel values for wild-growing mushrooms were 44.6-127, 0.4-15.9, 0.4-2, 8.2-26.7, 1.72-24.1 mg/kg[16,21,22,36,40], respectively. Though the nickel levels are generally in agreement with previous studies, the obtained nickel levels are higher than the allowed amount (0.05-5.00 mg/kg) of National Academy of Sciences[46] for plants and foods. Nickel has been linked to lung cancer[47] and the tolerable upper intake level for this toxic element is reported as 1 mg/day[25].

Cadmium is known as a principal toxic element, since it inhibits many life processes[48]. Cadmium has been associated with renal damage; cancer and childhood aggression [International Agency for Research on cancer[49]]. Mushroom, in particular, can be very rich in cadmium. Cadmium was measured as not detected in *Rhizopogon luteolus*, *Chroogomphus rutilus*, *Lactarius deliciosus* and it was the highest in *Mitrophora semilibera* (8.67 mg $kg^{-1}$ dw) which is relatively high compared to reported literature data[35,40,50,51]. The consumption of these mushrooms is likely to cause Cd body burden judging from the acceptable daily intake of 0.06-0.07 mg/day[45]. It was reported that cadmium is accumulated mainly in kidneys, spleen and liver and its blood serum level increases considerably, following mushroom consumption[21]. Thus, cadmium seems to be the most deleterious one among heavy metals in mushrooms. Its acceptable daily or weekly intake may be easily reached by consumption of an accumulating mushroom species[51].

*Morchella deliciosa*, *Tricholoma fracticum* and *Ramaria flava* were found to accumulate the cobalt at highest level, though it was not detected in many of the mushrooms studied. Cobalt content ranged from not detected to 10.92 mg/kg dw. The concentration of cobalt is relatively low. Cobalt values in the literature have been reported in the ranges: 0.12-0.62 mg/kg[34] and 0.15-6.03 mg/kg[22], respectively. Present cobalt values are in agreement with those reported in the literature except for *Morchella deliciosa*.

Results from over 150 original papers, dealing with heavy metals in edible mushrooms show that cadmium, mercury and lead are the toxic metals for man[21]. According to FAO/WHO[45] standards, acceptable intakes of cadmium and lead for an adult are 0.42-0.49 and 1.5-1.75 mg/week, respectively. The trace element concentrations in mushrooms are generally species-dependent[21] and hardly affected by pH or organic matter content of the soil[40].

According to the EU Scientific Committee for Food Adult Weight parameter, 60 kg of body weight was used for intake calculations as the weight of an average consumer. In addition, for intake calculations, usually a 300 g portion of fresh mushrooms, which contains 30 g of dry matter, per meal is assumed[6,18,21]. The metal intakes by a normal (60 kg) consumer in mg/serving for *Morchella deliciosa*, *Macrolepiota excoriata* and *Tricholoma populinum* were calculated from Table-2 as 0.91 and 0.09 for Pb and 0.760, 0.10 and 0.81 for Cd, respectively .These results conform to EU Scientific Committee[52] standards for Pb, Cd and Cr (toxic metals). Provisional tolerable weekly intake values for Pb and Cd for adults (of 60 kg) are 1.50 and 0.42 mg, respectively[52]. These values correspond to 0.21 and 0.06 mg of Pb and Cd, respectively, on a daily basis. Therefore, the intake of heavy metals (Pb, Cd) by consumption of 30 g dry weight of mushrooms daily poses no risk at all for the consumer.

Gürsoy *et al.*[18], found that mean values as mg/kg dry weight for Ca (742.00), Mg (974.00), Fe (96.00), Zn (93.80), Cu (18.94), Cr (nd) Mn (18.08), Pb (1.14), Ni (2.06), Cd (1.04) and Co (0.35) in *Morchella deliciosa* in Mugla, Turkey. In this study, Fe (7156), Cr (80.03), Mn (91.21), Pb (3.10), Ni (174.15), Cd (2.53) and Co (10.92) found in *Morchella deliciosa* higher than that study. It must be due to the habitat which is along the Kahramanmaras-Andirin highway.

In general, most of the mushrooms studied contained considerably high amounts of metals. In this study, metal contents of wild-growing mushrooms were generally higher than those reported from Turkey and other countries. Especially, *Morchella deliciosa* was found to have the highest concentrations of metal contents.

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