Levels of Trace Metals in Some Macrofungi from Buyuk Menderes River

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Nazmi Durkan
Pamukkale University

Yunus Dogan
Dokuz Eylul University

LEVELS OF TRACE METALS IN SOME MACROFUNGI FROM BUYUK MENDERES RIVER BASIN

Nazmi D U R K A N [1], Yunus D O G A N [2], Mehmet Cuneyt U N V E R [3], Mustafa I S I L O G L U [4] and Kudret K A B A R [5]

1 Faculty of Education, Pamukkale University, 20020 Denizli, Turkey.
2 Buca Faculty of Education, Dokuz Eylul University, 35150 Buca-Izmir, Turkey, e-mail: yunus.dogan@deu.edu.tr
3 Faculty of Education, Artvin Çoruh University, 08000 Artvin, Turkey.
4 Department of Biology, Faculty of Arts and Sciences, Muğla University, 48000 Kötekli- Muğla, Turkey.
5 Biology Department, Faculty of Arts and Sciences, Süleyman Demirel University, 32260 Isparta, Turkey.

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SYNOPSIS

The amounts of eight trace elements, chrome, manganese, iron, nickel, copper, zinc, cadmium, and lead in five macrofungi species collected from Büyük Menderes River Basin in South-western part of Turkey were determined by ICP-OES. The mean values for 8.088 mg/kg in Cr, 54.23 mg/kg in Mn, 1773.4 mg/kg in Fe, 22.961 mg/kg in Ni, 27.036 mg/kg in Cu, 43.106 mg/kg in Zn, 0.851 mg/kg in Cd and 2.808 mg/kg in Pb (dry matter) were determined. The highest values were: 27.09 mg/kg Cr, 176.4 mg/kg Mn, 4858 mg/kg Fe, 87.46 mg/kg Ni in *Helvella leucomelaena,* 39.55 mg/kg Cu in *Lepiota griseovirens*, 75.91 mg/kg Zn in *Helvella leucomelaena,* 2.044 mg/kg Cd in *Lepiota griseovirens*, 4.793 mg/kg Pb in *Helvella leucomelaena*. Results obtained are consonant with data that were reported in the related literature.

INTRODUCTION

Mushrooms are known to uptake and accumulate some polluting toxic and essential elements in high concentrations. Heavy metal concentrations in mushroom are considerable higher than those in agricultural crop plants, vegetables and fruits (Manzı et al., 2001). Many investigations have dealt with the metal contents of mushroom, especially edible ones (Lepšová & Král,

1988) and numerous data have been published on the contents of heavy metals in mushrooms (Stijve & Roshnik, 1974; Vetter, 1993).

The principal factors influencing the accumulation of heavy metals in macrofungi are environmental factors as metal concentrations in the soil, pH, organic matter, contamination by atmospheric deposition and fungal factors as fungal structure, biochemical composition, decomposition activity, development of mycelium and fruit bodies, morphological portion (García et al., 1998).

Turkey has a very rich macrofungal flora because it possesses favourable environmental conditions for the growth of edible, inedible and poisonous macrofungi. However, the Turkish public rarely consumes wild edible macrofungi (Yilmaz et al., 2003).

The purpose of this study was to determine the contents of eight heavy metals in five macrofungi collected from Büyük Menderes River Basin.

MATERIALS AND METHODS

The research area, Büyük Menderes River Basin is located in South-western Anatolian part of Turkey. It is a big area as 3.5% part of Turkey. It comes through Aegean Region to Aegean Sea as gathering agricultural and urban wastes from many arms of Büyük Menderes River (Fig. 1).

Figure 1: Map of study area and arms of Büyük Menderes River Basin.

The macrofungal samples for this research were collected from some localities of the research area in spring and summer periods of the years of 2004 and 2005. They were dried at 50^{o}C for 48 hours. The dried samples were kept in a polyethylene bags until analysis. After drying process, 25 mL nitric acid was added on to 2 g dried sample. It was heated slowly in a heater for 30 minutes and was left to get cold. Then 15 mL perchloric acid was added and was boiled about 1 hour until it became colorless in a magnetic heater. After it got cold, 50 mL deionized water was added. The samples were kept in polyethylene bottles at 4°C in a fridge until analyzing stage (Haswell, 1991).

Some amounts of chrome, manganese, iron, nickel, copper, zinc, cadmium, and lead were measured from some mushrooms collected from Büyük Menderes River Basin. The analysis of these elements in macrofungi were done by Perkin Elmer Optima 2100 DV ICP-OES.

RESULTS AND DISCUSSION

The trace elements contents of five different macrofungi species, collected from our study area, various arms of the Büyük Menderes River Basin are presented in the Table 1. In totally, eight different essential elements were observed and the highest Cr level is in *Helvella leucomelaena* (27.09 mg/kg dry weight (d.w)), the lowest is in *Volvariella murinella* (1.301 mg/kg d.w.). Although there is a overlapping in Cr amounts between our study and YAMAÇ et al. (2007); this is very low in other studies (Kalač & Svoboda, 2000; Demirbaş, 2001; Işildak et al., 2004; Mendil et al., 2004; Mendil et al., 2005). The high Cr accumulation of *Agaricus* spp. species also were determined (Kalač & Svoboda, 2000). The high affinity of some species to some metals indicated that they can take high amounts of metals in their bodies by using active transport. This state showed that the substrate composition is important.

The highest level of Mn was found in *Helvella leucomelaena* as 176.4 mg/kg d.w, the lowest is in *Paxillus rubicundulus* as 10.14 mg/kg d.w. The Mn amount is determined between 5 and 60 mg/kg d.w. in some studies (Kalač & Svoboda, 2000). In our study, Mn amount higher than in other literature. However, it is similar with some species in YAMAÇ et al. (2007).

It is found that the highest level of Fe is in *Helvella leucomelaena* (4858 mg/kg d.w.), and its lowest level is in *Lepiota griseovirens* (2826 mg/kg d.w.). In generally most of the taxa have a high level of Fe. It is because of naturally existence of high Fe amount in soil and Fe affinity of some species. There is a similarity in the results between our study and other studies (Sesli & Tüzen, 1999; Işiloğlu et al., 2001; Türkekul et al., 2004; Yamaç et al., 2007).

The highest level of Ni was found in *Helvella leucomelaena* as 87.46 mg/kg d.w., and the lowest is in *Lepiota cristata* as 3.866 mg/kg d.w. Ni amount in *Helvella leucomelaena* extremely higher than in literature (0.4-2 mg/kg d.w.) (Kalač & Svoboda, 2000).

The highest level of Cu was found in *Lepiota griseovirens* (39.55 mg/kg d.w.), and the lowest is in *Paxillus rubicundulus* (9.654 mg/kg d.w.). Although there is a overlapping in Cu amounts between our study and TÜZEN et al. (1998); it is very lower than result of YAMAÇ et al. (2007) (144.2 mg/kg d.w.).

This result shows that the Cu content of mushrooms depends on the species of mushrooms (Tüzen et al., 1998).

Table 1: Trace metal concentrations in mushroom (mg/kg, dry weight basis).

Class, family and species of mushrooms	Cr	Mn	Fe	Ni	Cu	Zn	Cd	Pb
Ascomycetes Helvellaceae								
Helvella leucomelaena (Pers.) Nannf.	27.09	176.4	4858	87.46	36.26	75.91	0.549	4.793
Basidiomycetes Paxillaceae								
Paxillus rubicundulus P.D. Orton	1.366	10.14	315.4	5.666	9.654	23.45	0.554	1.380
Pluteaceae								
Volvariella murinella (Quèl.) M.M. Moser	1.301	11.20	422.8	6.417	23.31	19.66	0.599	1.741
Agaricaceae								
Lepiota cristata (Bolton) P. Kumm.	2.654	11.50	444.8	3.866	26.41	50.04	0.511	2.413
Lepiota griseovirens Maire	8.033	61.91	2826	11.40	39.55	46.47	2.044	3.717

The highest level of Zn was found in *Helvella leucomelaena* (75.91 mg/kg d.w.) and it is the lowest in *Volvariella murinella* (19.66 mg/kg d.w.). Mushrooms are known as zinc accumulators and the sporophore: substrate ratio for Zn ranges from 1 to 10 mg/kg (Bano et al., 1981; Işiloğlu et al., 2001). The Zn concentrations of previous studies were between 30 and 150 mg/kg d.w. (Kalač & Svoboda, 2000).

The highest level of Cd was found in *Lepiota griseovirens* (2.044 mg/kg d.w.) and it is the lowest in *Lepiota cristata* (0.511 mg/kg d.w.). Different results in two different species in the same family indicated that metal affinities of mushrooms are different.

There is a similarity on Cd amount between our result and the literature (Tüzen et al., 1998; Yamaç et al. 2007). It is extremely high in some studies; 5-50 mg/kg in ZURERA et al. (1987), SOVA et al. (1991), KALAČ and SVOBODA (2000), and YEŞIL et al. (2004). It is low in other studies (Işildak et al., 2004; Mendil et al., 2004; Türkekul et al., 2004; Mendil et al., 2005).

The highest Pb level was found in *Helvella leucomelaena* (4.793 mg/kg d.w.) and it is the lowest in *Paxillus rubicundulus* (1.380 mg/kg d.w.). Pb amount in this study higher than TÜZEN et al. (1998), SESLI and TÜZEN (1999), DEMIRBAŞ (2000), YEŞIL et al. (2004) and IŞILDAK et al. (2004). It is lower than YILMAZ et al. (2003), MENDIL et al. (2004, 2005) and YAMAÇ et al.

(2007). Extremely high levels of Pb (100-300 mg/kg d.w.) were observed in many species in the close vicinity of smelters (Dolischka & Wagner, 1981; Liukkonen-Lilja et al., 1986; Kalač & Stašková, 1991; Lepšová & Král, 1988).

CONCLUSIONS

Metal amounts in two different species from Agaricaceae family collected from same area show different metal affinity.

In general, there is a similarity on metal amount found in Turkey and other countries**.**

The contamination of environment by heavy metals causes a serious problem because they cannot be naturally degraded like organic pollutants and they accumulate in different parts of the food chain. So, application of the established sampling procedures and determination methods for xenobiotics in environmental samples can be successfully applied for the purpose of analyses in biomonitoring.

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