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HEAVY METAL LEVELS IN SOME MACROFUNGI FROM BÜYÜK MENDERES RIVER BASIN, TURKEY

Nazmi DURKAN¹, Mustafa IŞILOĞLU², Kudret KABAR³, Yunus DOĞAN^{4*}

¹Faculty of Education, Pamukkale University, 20020 Denizli, Turkey

²Department of Biology, Faculty of Arts and Sciences, Muğla University, 48000 Kötekli- Muğla, Turkey

³Biology Department, Faculty of Arts and Sciences, Süleyman Demirel University, 32260 Isparta, Turkey

⁴Buca Faculty of Education, Dokuz Eylül University, 35160 Buca-İzmir, Turkey

*E-mail: yunus.dogan@deu.edu.tr

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SYNOPSIS

This study was done with 8 taxa of macrofungi (1 edible, 6 inedible and 1 poisonous) collected from Büyük Menderes River Basin in Southwest of Turkey. The amounts of Cr, Mn, Cu, Fe, Zn, Cd and Pb metals accumulated in macrofungi taxa were analyzed with ICP-OES. According to results of the analysis, the amounts of metals (dry matter) were; 22,43 mg/kg Cr in *Funalia trogii*, 39,54 mg/kg Mn, 3027 mg/kg Fe and 19,42 mg/kg Pb in *Stereum hirsutum*, 78,58 mg/kg Ni, 43,78 mg/kg Cu and 202,1 mg/kg Zn in *Fomes fomentarius* and 0,663 mg/kg Cd in *Suillus bellinii*. These results were correlated with the results of the metal amounts found in the soil where macrofungi samples were collected.

INTRODUCTION

Macrofungi are important organisms in the ecosystem because of their ability to biodegrade the substrate and they use the wastes of agricultural production as substrates. Human activity leads to increasing levels of heavy metal contamination in the environment. The determination of heavy metals in soil samples is very important in monitoring of environmental pollution.

The trace element contents of the species depend on the ability of the species to extract elements from the substrate, and on the elective uptake and accumulation of elements in tissues (SESLİ & TÜZEN, 1999; DEMİRBAŞ, 2001; IŞILDAK & al., 2004). Heavy metal concentrations in mushroom are considerable higher than those in agricultural crop plants, vegetables and fruits (MANZI & al. 2001). Relatively some mushroom species get more metals, while some others accumulate less metal (WETZELL, 1979; SEEGER, 1982). The concentration variations of heavy metals could be considered due to mushrooms species and their ecosystems (SEEGER, 1982). The heavy metal concentrations in the mushroom are hardly affected by pH or

organic matter content of the soil (GAST & al., 1988; SESLİ & TÜZEN, 1999; DEMİRBAŞ, 2002).

The aim of this study is to investigate of the level of heavy metals pollution of the river basin by using some macrofungal taxa growing in the area.

MATERIALS AND METHODS

The research area, Büyük Menderes River Basin located in Southwest Anatolia. It is 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.1a, b).



Fig. 1. a) Satellite image of Büyük Menderes River Basin, b) Map of the study area.

Macrofungal samples: The macrofungal samples for this research were collected from some stations of the research area in spring and summer periods of the years of 2004 and 2005. They were dried at 50°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 gr 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 colourless 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).

The soil samples: In 250 mg soil sample was added 4 mL nitric acid and 1 mL perchloric acid and was heated about 2 hours until the gas scold. When the gas scold finished, the heat was raised to 185°C and they were left at this temperature to dry. After drying process, they got cold and 2 mL hydrochloric acid was added and they were heated at 60°C about 1 hour. When they got cold again, 8 mL deionized water was added and were filtered in a microfiltration apparatus. The samples were kept in polyethylene bottles at +4°C in a fridge (HASWELL, 1991).

The analysis of Cr, Mn, Fe, Ni, Cu, Zn, Cd and Pb elements in macrofungi and soil samples were done by Perkin Elmer Optima 2100 DV ICP-OES.

RESULTS AND DISCUSSION

Metal distributions of mushroom and soil samples are given in Table 1. The highest value of Cr was 22.43 mg/kg d.w. in *Funalia trogii* whereas the lowest level was 0.045 mg/kg d.w. in *Fomes fomentarius* (Fig. 2). It was not found any record in the related literature about Cr in these species. It was determined that the value of Cr in soil sample in which the *Funalia trogii* was grown, was quite high. The reason was the arm of river Büyük Menderes which comes from the city of Uşak and has got a massive leather industry and its discharges throughout. In these mushroom species, this metal was probably accumulated from the soil by active transportation.

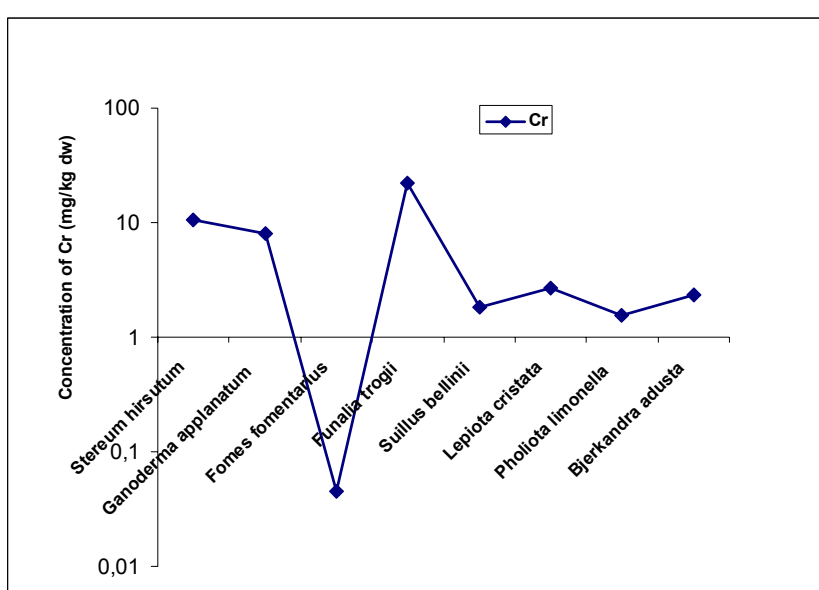


Fig. 2. Distribution of Cr content in mushroom taxa.

It was determined that the highest value of Mn was 39.54 mg/kg d.w. in *Stereum hirsutum* and lowest value of Mn was 6.962 mg/kg d.w. in *Pholiota limonella* (Fig. 3). It was not found any record in the related literature about Mn in *Stereum hirsutum*. The level of Mn was quite high in *Stereum hirsutum* and in the soil samples. The reason of this situation was probably the discharge of some factories formed in this arm of Büyük Menderes River.

It was determined that the highest value of Fe content was 3027 mg/kg d.w. in *Stereum hirsutum* and the lowest level was 99.71 mg/kg d.w. in *Pholiota limonella* (Fig. 4). It was observed that Fe wasn't studied *Stereum hirsutum* in the literature. The level of Fe in *Stereum hirsutum* was quite high and in the soil samples. Most probably the reason was discharging of some factories in this arm of Büyük Menderes River.

It was determined that the highest value of Ni was 78.58 mg/kg d.w. in *Fomes fomentarius* and the lowest level was 6.962 mg/kg d.w. in *Pholiota limonella* (Fig. 5). It was seen the Ni wasn't studied in *Fomes fomentarius* to literature values. Ni level was high in *Fomes fomentarius* and in the soil samples. Most probably the reason was discharging of some factories in this arm of Büyük Menderes River.

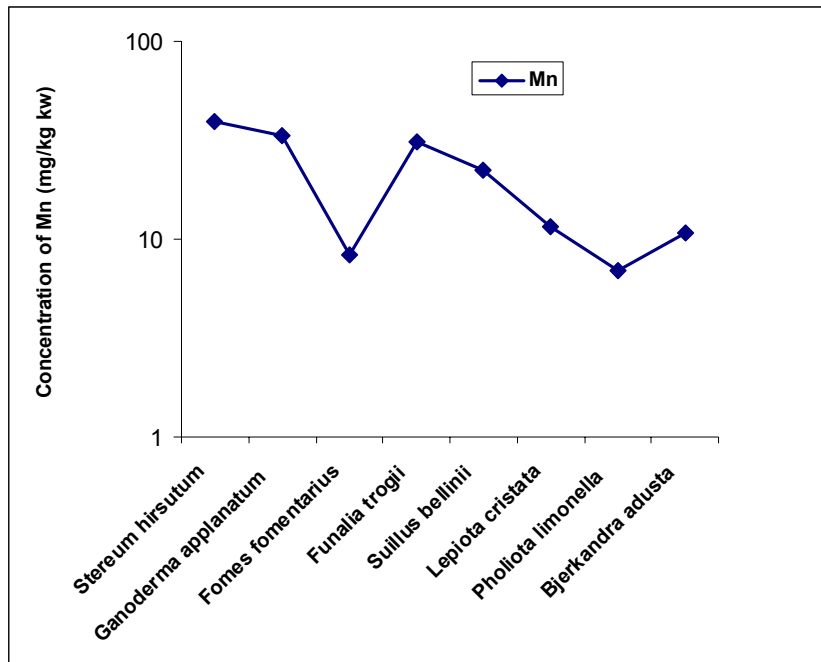


Fig. 3. Distribution of Mn content in mushroom taxa.

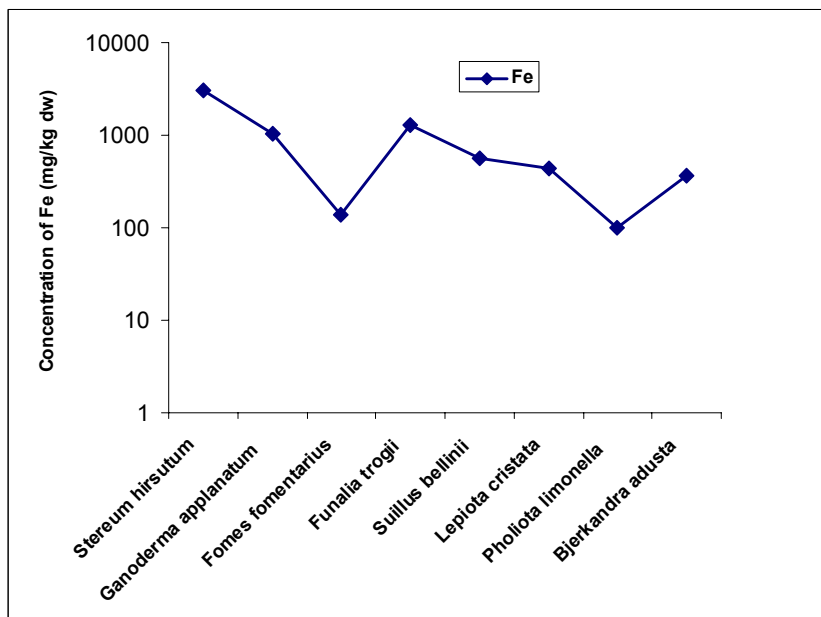


Fig. 4. Distribution of Fe content in mushroom taxa.

It was determined that the highest value of Cu was 43.78 mg/kg d.w. in *Fomes fomentarius* and the lowest level was 7.694 mg/kg d.w. in *Funalia trogii* (Fig. 6). Our results are in agreement with the results of TÜRKEKUL & al. (2004), on the other hand they are not in harmony with those of YEŞİL's & al. (2004), since their results

were lower than ours. While, the Cu level was determined as 21.28 mg/kg d.w. in the soil.

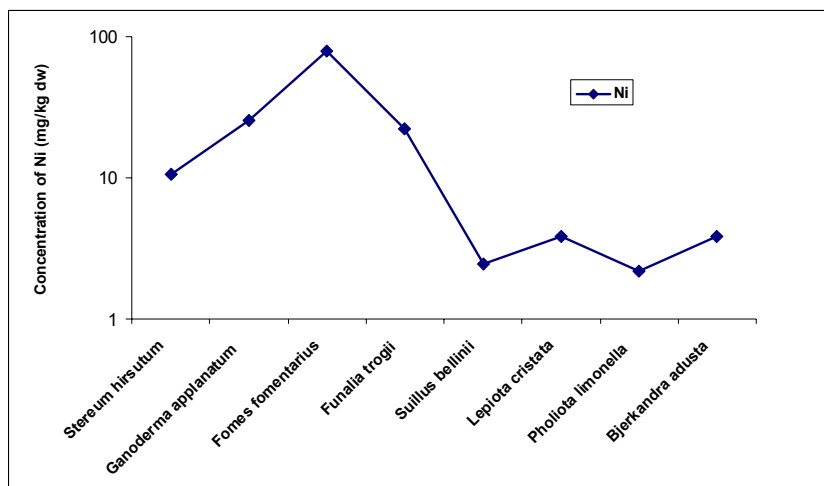


Fig. 5. Distribution of Ni content in mushroom taxa.

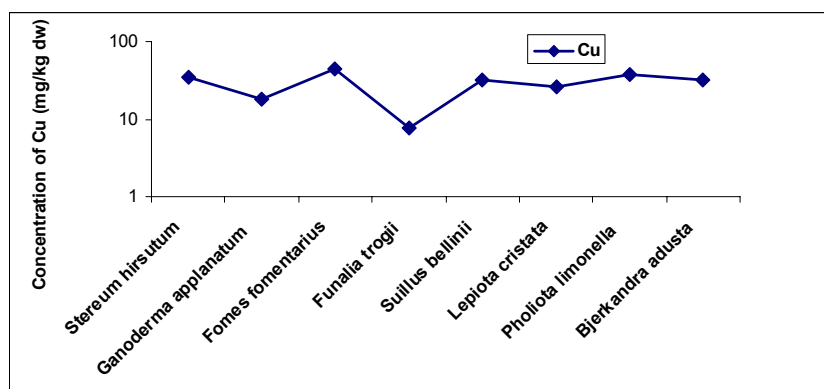


Fig. 6. Distribution of Cu content in mushroom taxa.

It was determined that the highest value of Zn was 102.1 mg/kg d.w. in *Fomes fomentarius* and the lowest level was 30.77 mg/kg d.w. in *Ganoderma applanatum* (Fig. 7). Zn level determined in this study in *Fomes fomentarius* was quite high when compared to results of TÜRKEKUL & al. (2004) and YEŞİL & al. (2004). It was also determined that Zn metal was 261.6 mg/kg d.w. in soil. The amount of accumulation of Zn in *Fomes fomentarius* was half of the same level in the soil. This situation support the idea offered by WETZELL (1979) and SEEGER (1982) that the mushroom are affected less from some metals.

It was determined that the highest value of Cd was 0.663 mg/kg d.w. *Suillus bellinii* and the lowest level was 0.078 mg/kg d.w. in *Funalia trogii* (Fig. 7). When Cd level in *Suillus bellinii* was compared with the results of YILMAZ et al. (2003), it was seen that they were in harmony with each other. *Suillus bellinii* could be eaten but it was harmful for human health because of growing in the polluted area. Cadmium is accumulated mainly in kidney, spleen, liver and its level in blood serum increases

considerably following mushroom consumption (KALAC & SLOBODO, 2000). Thus, cadmium seems to be the most deleterious among heavy metals in mushrooms. Its acceptable daily or weekly intake may be easily reached by consumption of an accumulating mushroom species (KALAC & al., 2004).

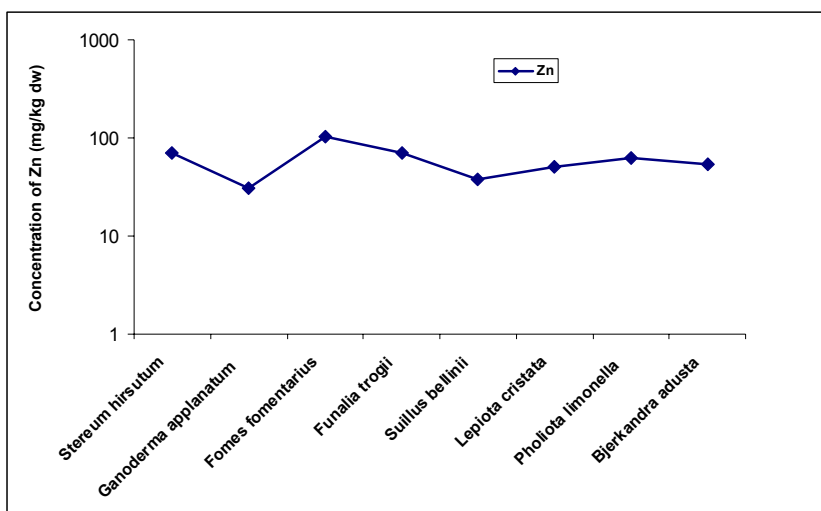


Fig. 7. Distribution of Zn content in mushroom taxa.

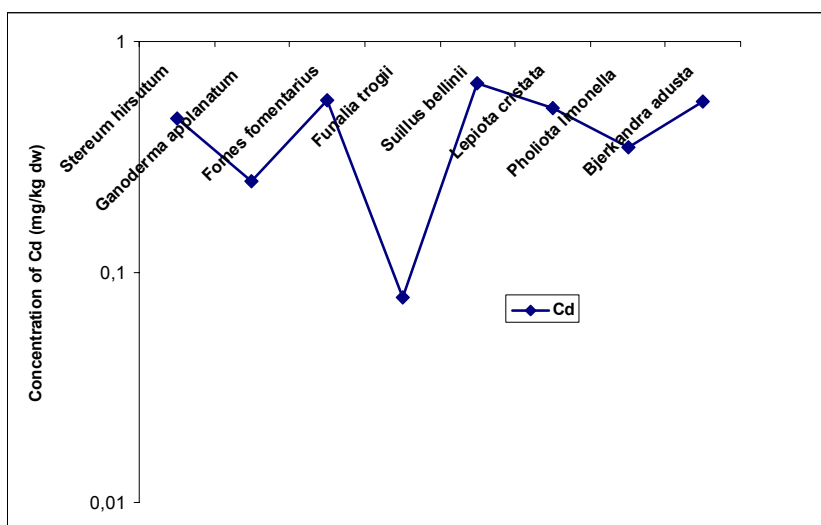


Fig. 8. Distribution of Cd content in mushroom taxa.

It was determined that the highest value of Pb in *Stereum hirsutum* was 19.42 mg/kg d.w. and the lowest level was 1.542 mg/kg d.w. in *Pholiota limonella* (Fig. 7). In the related literature on Turkish macrofungi, Pb levels were determined in between 0.35-8.0 mg/kg d.w. in samples studied by some Turkish researchers with different mushroom taxa (YILMAZ, 2000; DEMİRBAŞ, 2002; TÜZEN, 2003, IŞILDAK & al., 2004; MENDİL et al. 2004, YEŞİL & al. 2004; MENDİL & al., 2005). The level of Pb in the soil where *Stereum hirsutum* is grown was identified as 42.62 mg/kg d.w. This high

level of Pb accumulation in the soil could come from the industrial and domestic wastes.

As a result, heavy metal contents in some macrofungi and in soil around Büyük Menderes Basin were found and it was determined that the metal levels in some macrofungi were higher than the soil level. This showed that some macrofungi took more metal by active transportation. Even though macrofungi took more metals in their body, while some took less metals (WETZELL, 1979; SEEGER, 1982).

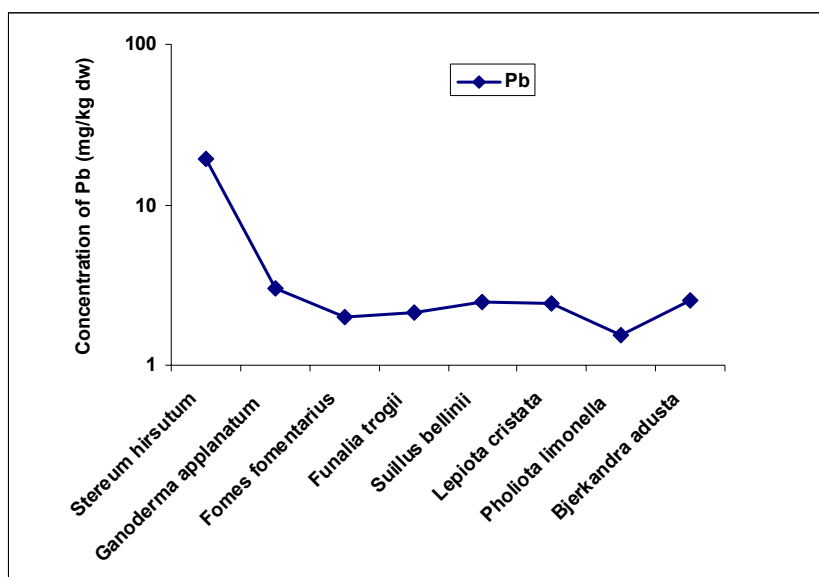


Fig. 9. Distribution of Pb content in mushroom taxa.

	Family	LN	Cr	Mn	Fe	Ni	Cu	Zn	Cd	Pb
Species										
<i>Stereum hirsutum</i> (Willd.) Pers., NE	Stereaceae	2	10.66	39.54	3027	10.53	34.08	70.32	0.461	19.42
<i>Ganoderma applanatum</i> (Pers.) Pat., NE	Ganodermataceae	2	8.086	33.59	1051	25.46	17.97	30.77	0.247	3.021
<i>Fomes fomentarius</i> (L.) J.J. Kickx, NE	Polyporaceae	2	0.045	8.366	137.4	78.58	43.78	102.1	0.558	2.019
<i>Funalia trogii</i> (Berk.) Bond. et Sing., NE	Polyporaceae	6	22.43	31.17	1274	22.09	7.694	69.61	0.078	2.126
<i>Suillus bellinii</i> (Inz.) Watling, E	Suillaceae	4	1.836	22.19	566.5	2.460	31.32	37.88	0.663	2.462
<i>Lepiota cristata</i> (Bolton) P. Kumm., P	Agaricaceae	5	2.654	11.50	444.8	3.866	26.41	50.04	0.511	2.413
<i>Pholiota limonella</i> (Peck) Sacc., NE	Strophariaceae	3	1.541	6.962	99.71	2.163	36.87	62.05	0.347	1.542
<i>Bjerkandera adusta</i> (Willd.) P. Karst., NE	Hapalopilaceae	1	2.351	10.83	366.0	3.824	31.42	53.17	0.547	2.528
		Min:	0.045	8.366	99.71	2.163	17.97	30.77	0.247	1.542
		Max:	22.43	39.54	3027	78.58	43.78	102.1	0.663	19.42
Soil										
		1	29.96	181.9	2856	42.34	9.939	62.41	0.808	4.770
		2	312.1	729.7	21080	494.6	21.28	261.6	1.131	42.62
		3	43.74	495.2	19580	55.24	9.119	90.119	1.075	13.53
		4	74.27	483.4	15780	72.00	9.115	105.9	0.957	17.21
		5	58.72	514.9	13750	62.19	8.544	88.78	0.950	17.41
		6	15250	598.8	14500	188.2	44.18	297.0	0.344	34.24
	Standard gaps of metals (Kloke 1980)		1-10	-	-	2-5	1-20	3-50	0.1-1.0	0.1-20

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

LN: locality number, E: edible, NE: non-edible, P: poisonous

Among the reasons for metal pollution in the soil could be urban and industrial wastes. Another reason could possibly be the polluted water affected the soil, agricultural products and all the living organisms benefited or affected from them.

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