Bull. Environ. Contam. Toxicol. (2004) 73:853–861

DOI: 10.1007/s00128-004-0505-y

Bulletin of Environmental Contamination and Toxicology

Level of Heavy Metals in Some Edible and Poisonous Macrofungi of Diyarbakir Region in Turkey

Ö. F. Yeşil,[1] A. Yildiz,[2] Ö. Yavuz[3]

[1] Department of Biology, Science Institute, Dicle University, 21280 Diyarbakir, Turkey
[2] Department of Biology, Dicle University, Faculty of Science and Arts, 21280 Diyarbakir, Turkey
[3] Department of Chemistry, Dicle University, Faculty of Science and Arts, 21280 Diyarbakir, Turkey

Received: 24 June 2003/Accepted: 8 September 2004

Natural or cultivated mushrooms are known to uptake and accumulate some polluting heavy metals in high concentration. Mushroms have attracted much interest recently as they may be used in order to determine the degree of pollution caused by polutant heavy metals. They may either be used as indicator organisms due to their great accumulating capacity or as cleaning agents for polluted areas (Gücin and Baltepe,1989).

Many investigations have dealt with the metal contents of mushroom, especially edible ones (Lepsova & Mejstrik, 1988) and numerous data have been published on the contents of heavy metals in mushrooms (Vetter, 1993; Stijve & Roshnik, 1974). Compared to green plants, mushrooms can build up large concentrations of some heavy metals such as Pb, Cd, and Hg (Allen & Steinnes, 1978; Tyler, 1982). As these metals are well-known for their loxicity at low concentrations, a great deal of effort has been made to evaluate the possible danger to human health from the ingestion of mushrooms (Gast et al, 1988).

Studies show that the concentrations of trace elements in the fruiting bodies of fungi tend to be species-specific. The concentrations were found to depend on the physiology of the species and particularty on its trophic pattern (Lepsova & Mejstrik, 1988). There were significant differences for both cadmium and mercury and no correlation between the metal contents and size (dry weight) of the fruiting body could be detected (Kojo, & Lodenius, 1989). As a result of environmental effects, generalized standard analysis methods for heavy metals in animal and vegetal tissues are required for calibration purposes. In a large number of publications,data have already been given about the contents of heavy metals in mushrooms (cultivated and in wild) (Stegnar et at.. 1973; Stijve and Roshnik. 1974; Stijve and Besson, 1976; Gast et al.. 1988; Latiff et al.. 1996). Compared to green plants, Mushrooms can build up large concentrations of some heavy metals such as Cd and Hg (Meisch et al., 1977; Kuusi et al., 1981).

Heavy metals represent an important group of toxic compounds that have been introduced into the environment mostly in connection with development of industry, traffic and other human activities. The sources of most heavy metals in

Correspondence to: A. Yildiz

the atmosphere are mainly combustion processes (burning of coal, oil or waste incineration), metal smelters and traffic. However, the sources of particular micro elements in the atmosphere are still not known exactly. Metal emissions pose adirect health hazard to people through inhalation. When deposited they can be taken up by vegetation and enter the food chain, resulting in exposure to humans. Fungi are known metal accumulators, metals are extensively bound to the outer layer of mycelia. Polysaccharides, proteins, as well as pigments seem to be involved in metal binding. Fungal species growing on wood contain, in general, lower concentrations of heavy metals than fungi growing on soil (Vetter, 1994). Uptake of metals from soil is the main source of metals in mycorhizal and saprophytic fungi (Gast et al., 1988). However, translocation of heavy metals from soil to fruiting bodies of wood-inhabiting species is limited. Here, atmospheric deposition (usually in the form of dust particles) is the most important source of metals. Content of anthropogenic metals in fungal fruiting bodies reflects current state of environmental pollution and wood-inhabiting fungi may serve as proper bioindicators.

MATERIALS AND METHODS

There have not been any previous studies on macrofungi growing in Diyarbakır (Yildiz and Ertekin 1996). Therefore, between 2001 and 2002 macrofungus specimens were collected from the province of Diyarbakır.

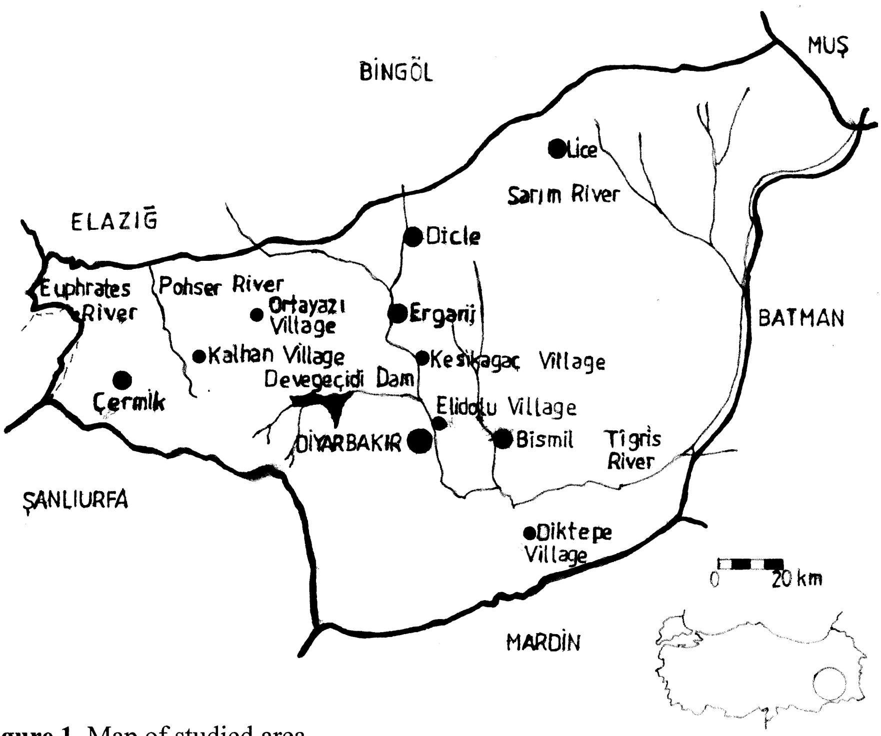

Figure 1. Map of studied area.

This study aims to determine the macrofungi in Diyarbakır, and to contribute the Turkey's macrofungi flora. The locations where the specimens were collected are shown in Figure 1. The specimens were photographed and then identified with the help of (Heim 1989; Marchand 1971-1973; Moser 1983; Bon 1987; Bas et al. 1990; Guinberteam 1990).

Solutions containing magnesium, copper, iron, manganese, cobalt, zinc, cadmium and lead ions were obtained by dissolution of ash in 10 ml of hydrochloric acid (0.1 N) and subsequent dillution to 100 ml with distillated water. Mg, Cu, Fe, Mn, Co, Zn, Cd and Pb were determined directly in the ash solution by atomic absorption spectrometer (AAS) (ATI UNICAM 929). The results were triplicated.

RESULTS AND DISCUSSION

A total of 49 different samples were analysed and we had 30 different macrofungi species. These 30 species of macrofungi that use identified around the locations of Diyarbakır (Figure 1) province belong to 16 families (Table 1). Avarage Pb content is 1,14 ppm for all macrofungi samples. The highest Pb level was 5,16 ppm for the species *Naematoloma fasciculare*, which was collected from Hevsel Gardens in Diyarbakır. The lowest Pb level was 0,17 ppm for *Fomes fomentarius*, which was collected from Gazi Köşkü (Table 2). The lower proportion of Pb of the washed mushrooms might be the result of high Pb pollution in the air (Tüzen et al, 1998). It has been reperted that Pb concentration may be high in samples grown in the vicinity of a road (Seeger, 1982). The present results are in agreement with values given in the literature (Seeger, 1982).

From Table 2, avarage Cd content is 1.14 ppm for all macrofungi samples. The highest Cd level was 9,48 ppm for the species, *Amanita vaginata,* which was collected from centrum of the Campus of the University of Dicle (Table 2).

The characteristic of only some of the taxaonimical categories (Veter, 1990). The main sources of atmospheric pollution by toxic metals are mining and burning of oil, coal and industrial facilities, mainly smelters (Gabriel et al,1997). The present results are supperted with values given in the literature (Veter, 1990).

From Table 2, avarage Fe content is 70.9 ppm for all macrofungi samples . The highest Fe level was 252 ppm for the species *Agaricus bisporus*, which was collected from the Campus of the University of Dicle (Table 2). The lowest Fe lewel was 5.3 ppm for *Helvella leucomelaena*, which was collected from the Campus of the Univercity of Dicle. It has been reported by (Latiff et al, 1996) that Fe contents were 100-1216 ppm in different species of mushrooms. In the cultivation mushroom (*P.ostreatus*) concentration of Fe was 0.012 g/g dry material (Yildiz et al, 1998). Althoug the values of Fe content fluctuate substantially, correlation of taxonomic character could not be established. However, It seems, that the species living on trees have an even lower Fe content in comparison to other species belonging to different types of nutrition (Vetter, 1990).

Table 1. Macrofungi collected from Diyarbakir, South East Anatolia (Turkey).

No	Class, Family and species of macrofungi	Habitat of Diyarbakır
	***ASCOMYCETES* (De bary)**	
	MORCHELLACEAE	
1	*Morchella conica* (Pers.)	Dicle University,under poplar trees
2	*Morchella conica* (Pers.)	Gazi Koksu, under poplar trees
	HELVELLACEAE	
3	*Helvella leucopus* (Pers.)	Dicle University, under poplar trees
4	*Helvella leucomelaena* (Pers.) Nannf	Çermik, Pohsor River under poplar trees
5	*Helvella leucomelaena* (Pers.) Nannf	Dicle University, under poplar trees
	PEZİZACEAE	
6	*Peziza-bodia confusa* (Korf.)	Dicle University, under pine trees
	***BASIDIOMYCETES*(Classe)**	
	SCHIZOPHYLLACEAE	
7	*Schizophyllum commune* (L.: Fr.)	Dicle University, on poplar stump
	AGARICACEAE	
8	*Agaricus bisporus* (Lange) Sing	Dicle University, meadow
9	*Agaricus campesteris* (L.) Fr.	Dicle University, meadow
10	*Agaricus xanthodermus* (Gen.)	Dicle University, meadow
11	*Gomphidus glutinosus* (Schff.) Fr.	Dicle University, meadow
	AMANITACEAE	
12	*Amanita vaginata* (Bull.: Fr.) Vitt.	Dicle University, under poplar trees
13	*Amanita verna* (Bull.: Fr.) Roques	Dicle University, around social facilities
14	*Amanita verna*(Bull.: Fr.) Roques	Dicle University, around greenhouse
15	*Amanita solitaria* (Fr.) Quel.	Dicle University, meadow
	COPRINACEAE	
16	*Coprinus atramentarius* (Bull. Ex Fr.)	Dicle University, meadow
17	*Coprinus atramentarius (Bull. Ex Fr.)*	Kesikağaç Village, meadow
18	*Coprinus micaceaeus* (Bull.: Fr.)	Dicle University, on willow stump
	TRICHOLOMATACEAE	
19	*Armillaria tabescens* (Scop. Fr.) Roques	Gazi Köşkü, on poplar stump
20	*Armillaria tabescens* (Scop. Fr.) Roques	Kesikağaç Village, on mulbery stump
21	*Armillaria tabescens* (Scop. Fr.) Roques	Elidolu Village, on poplar stump
22	*Armillaria tabescens* (Scop. Fr.) Roques	Ergani, Çayönü, on poplar stump
23	*Clitocybe squamulosa*(Pers.: Fr) P. Kumm	Dicle University, meadow
24	*Tricholoma terreum* (Schaeff.:Fr.) P. Kumm	Deve Geçidi Dam, under poplar trees
25	*Flammulina velutipes* (Curtis ex.Fr.) Sing.	Dicle University, under pine trees
	POLYPORACEAE	
26	*Pleurotus ostreatus* (Jacq. Ex Fr.) Kumm	Dicle University, on poplar stump
27	*Pleurotus ostreatus* (Jacq. Ex Fr.) Kumm	Dicle University, on poplar stump
28	*Pleurotus ostreatus* (Jacq. Ex Fr.) Kumm	Ergani,Çayönü, on poplar stump
29	*Pleurotus olearius* (D. C. Ex. Fr.) Gillet	Dicle University, on poplar stump
	PLUTACEAE	
30	*Volvariella speciosa* (Fr.: Fr.) Singer	Dicle University, meadow
31	*Volvariella speciosa* (Fr.: Fr.) Singer	Dicle University, meadow
32	*Volvariella speciosa* (Fr.: Fr.) Singer	Kesikağaç Village, meadow

Table 1. Continued

	BOLBITACEAE	
33	*Agrocybe aegarita* (Brig.) Singer	Kesikağaç Village, on mulbery stump
34	*Agrocybe aegarita* (Brig.) Singer	Dicle, on poplar stump
35	*Agrocybe aegarita* (Brig.) Singer	Çermik, Around Pohsor River, on willow stump
	STROPHORIACEAE	
36	*Naematoloma fasciculare* (Huds.: Fr.) Karst.	Hevsel Gardens, on poplar stump
37	*Naematoloma fasciculare* (Huds.: Fr.) Karst	Çermik, Around Pohsor River, on willow stump
38	*Naematoloma fasciculare* (Huds.: Fr.) Karst	Bismil,Diktepe Village, on poplar stump
	POLYPORACEAE	
39	*Funalia trogii* (Berk. Apud Trag) Bond et Sing	Bismil, Diktepe Village, on poplar stump
40	*Funalia trogii* (Berk. Apud Trag) Bond et Sing	Dicle University, on poplar stump
41	*Coriolus versicolor* (L. ex Fr.) Quel.	Çermik, Pohsor River, on poplar stump
42	*Coriolus versicolor* (L. ex Fr.) Quel	Ergani,Ortayazı Village, on walnut trees
43	*Fomes fomentarius* (L. ex Fr.) Fr.	Gazi Köşkü, on mulbery stump
44	*Fomes fomentarius* (L. ex Fr.) Fr.	Ergani-Maden 10 th km, on poplar stump
	CORTINARIACEAE	
45	*İnocybe fastigiata* (Schaeff.) Fr.	Lice, Sarım River, under trees poplar
46	*Boletus luteus*(L ex Fr.) Kummer	Dicle University, under pine trees
47	*Boletus luteus*(L ex Fr.) Kummer	Dicle University, under pine trees
	CLAVARIACEAE	
48	*Ramaria mairei* (Donk)	Ergani, Kalhan Village under poplar trees
	ENTOLOMATACEAE	
49	*Clitopilus prunulus* (Scop. Ex Fr.Kummer	Dicle University, meadow

Table 2. Heavy metal levels in macrofungi of Diyarbakir (ppm, dry weight)

No	Pb	Cd	Fe	Cu	Mn	Zn	Co
1	1.24 ± 0.22	0.92 ± 0.18	140 ± 11	18.2 ± 1,2	38.3 ± 2.2	26.4 ± 1.8	9.3 ± 2.4
2	0.79 ± 0.24	1.07 ± 0.27	58.7 ± 5.6	37.2 ± 2.4	22.3 ± 1.8	30.5 ± 2.4	17.1 ± 3.2
3	0.67 ± 0.18	4.19 ± 0.52	17.1 ± 2.3	38.7 ± 2.8	8.8 ± 0.5	32.2 ± 3.5	4.8 ± 1.2
4	0.35 ± 0.05	1.11 ± 0.42	12.8 ± 0.9	14.4 ± 0.6	36.6 ± 3.5	24.4 ± 1.3	12.2 ± 3.1
5	0.23 ± 0.09	0.13 ± 0.02	5.3 ± 0.3	2,8 ± 0,1	14.3 ± 0.4	15.8 ± 1.9	4.7 ± 1.2
6	0.99 ± 0.11	0.24 ± 0.05	67.4 ± 8.3	15.8 ± 0.9	16.3 ± 2.6	20.2 ± 2.1	9.9 ± 2.4
7	0.35 ± 0.17	0.72 ± 0.17	68.1 ± 6.4	3,7 ± 0.0	15.5 ± 1.1	21.0 ± 1.3	7.1 ± 1.3
8	2.28 ± 0.29	4.71 ± 0.48	252 ± 21	50.6 ± 4.6	30.6 ± 3.7	40.3 ± 3.1	20.3 ± 3.8
9	0.55 ± 0.17	0.64 ± 0.13	29.9 ± 4.3	32.7 ± 3.1	10.4 ± 1.5	22.7 ± 1.5	5.2 ± 1.3
10	0.64 ± 0.05	0.78 ± 0.16	44.7 ± 5.8	45.7 ± 4.6	30.2 ± 2.9	17.2 ± 1.1	0.89 ± 0.12
11	0.84 ± 0.16	4.02 ± 0.37	34.2 ± 2.6	39.8 ± 3.4	41.3 ± 3.4	27.6 ± 2.5	4.8 ± 1.3
12	0.86 ± 0.22	9.48 ± 0.86	94.2 ± 9.2	15.2 ± 1.8	147 ± 12	26.4 ± 2.4	9.9 ± 3.4
13	4.04 ± 0.05	1.42 ± 0.28	61.4 ± 7.4	79.4 ± 5.2	14.2 ± 1.3	28.3 ± 1.5	20.9 ± 3.6
14	ND	0.51 ± 0.18	67.1 ± 5.8	30.9 ± 3.7	5.5 ± 0.2	98.3 ± 3.6	4.3 ± 1.4
15	1.25 ± 0.25	1.39 ± 0.22	57.5 ± 6.7	28.3 ± 1.5	18.6 ± 0.6	30.2 ± 2.8	12.2 ± 3.7
16	0.21 ± 0.33	0.64 ± 0.18	88.2 ± 11.0	19.5 ± 1.3	10.3 ± 0.3	2.98 ± 0.2	1.51 ± 0.15
17	ND	0.17 ± 0.05	129.5 ±13.6	29.8 ± 3.4	11.1 ± 1.1	118.5 ± 4.8	1.26 ± 0.18
18	1.46 ± 0.22	1.34 ± 0.26	223 ± 21	33.1 ± 2.4	23.9 ± 1.6	38.6 ± 3.1	36.3 ± 5.2
19	0.88 ± 0.08	0.69 ± 0.12	27.5 ± 4.9	6,2 ± 0.0	5.04 ± 0. 1	12.2 ± 0.5	19.8 ± 3.3
20	0.18 ± 0.06	5.01 ± 0.56	14.3 ± 1.6	1,9 ± 0.0	5.42 ± 0.1	7.5 ± 0.3	7.7 ± 1.2
21	0.68 ± 0.17	0.29 ± 0.11	47.8 ± 6.2	4.9 ± 0.8	10.3 ± 0.7	9.9 ± 0.4	7.1 ± 0.8
22	ND	0.21 ± 0.04	74.1 ± 8.4	7.1 ± 1.2	15.5 ± 1.4	45.2 ± 3.1	2.7 ± 0.7

Table 2. Continued

23	0.79 ± 0.15	2.01 ± 0.57	69.6 ± 4.7	45.8 ± 4.9	30.5 ± 3.4	32.7 ± 2.6	10.4 ± 2.5
24	1.55 ± 0.12	0.58 ± 0.14	103 ± 12	28.7 ± 2.1	35.3 ± 3.6	22.2 ± 1.6	12.1 ± 4.2
25	ND	0.82 ± 0.16	132.6 ± 11.2	92.5 ± 6.7	22.1 ± 2.8	154.3 ± 5.4	5.9 ± 1.3
26	0.94 ± 0.11	0.39 ± 0.17	41.5 ± 3.8	22.2 ± 1.6	6.5 ± 0.3	13.7± 1.3	12.6 ± 3.6
27	ND	0.13 ± 0.01	49.11 ± 3.5	5.6 ± 0.3	8.1 ± 0.8	98.8 ± 4.7	3.3 ± 0.4
28	ND	0.14 ± 0.01	47.7 ± 4.7	6.1 ± 0.4	6.2 ± 0.7	78.9 ± 2.9	1.2 ± 0.14
29	0.68 ± 0.16	0.88 ± 0.13	22.5 ± 3.4	5.1 ± 0.0	9.0 ± 0.3	13.7 ± 1.4	13.9 ± 2.3
30	1.01 ± 0.11	0.89 ± 0.15	89.0 ±9.2	39.4 ± 3.3	26.7 ± 1.8	32.6 ± 4.8	16.1 ± 1.2
31	ND	0.35 ± 0.14	166.3 ±13.2	49.8 ± 5.3	22.4 ± 1.5	36.5 ± 4.9	4.7 ± 1.7
32	0.56 ± 0.06	0.56 ± 0.06	11.3 ± 0.8	11.2 ± 1.2	14.9 ± 1.1	5.4 ± 0.1	11.2 ± 1.4
33	0.29 ± 0.09	0.97 ± 0.18	10.4 ± 1.1	16.1 ± 0.5	12.2 ± 0.9	19.0 ± 1.4	1.68 ± 0.45
34	0.28 ± 0.06	0.43 ± 0.12	10.4 ± 0.7	0.37 ± 0.01	6.1 ± 0.2	2.02 ± 0.0	8.5 ± 1.7
35	0.24 ± 0.11	0.48 ± 0.14	6.3 ± 0.4	0.18 ± 0.10	2.2 ± 0.1	0.21 ± 0.0	6.8 ± 2.1
36	5.16 ± 0.22	1.75 ± 0.33	214 ± 18	45.1 ± 6.4	22.8 ± 2.3	35.5 ± 3.4	14.1 ± 3.6
37	0.94 ± 0.18	0.45 ± 0.14	94.3 ± 7.8	10.8 ± 2.5	12.6 ± 0.8	21.9 ± 2.7	5.3 ± 1.1
38	ND	055 ± 0.12	141.6 ± 12.3	36.5 ± 2.9	9.7 ± 0.4	97.9 ± 4.5	15.8 ± 2.4
39	ND	0.01 ± 0.00	25.3 ± 2.1	22.9 ± 0.8	7.6 ± 0.2	2.8 ± 0.1	2.1 ± 0.3
40	2.11 ± 0.22	0.36 ± 0.08	52.0 ± 4.5	6.96 ± 2.30	5.4 ± 0.1	20.2 ± 3.2	14.0 ± 4.2
41	1.28 ± 0.06	0.72 ± 0.15	78.3 ± 8.2	9.2 ± 1.9	33.6 ± 3.5	10.0 ± 1.1	23.8 ± 3.7
42	ND	0.21 ± 0.02	50.2 ± 4.8	1.8 ± 0.3	7.1 ± 0.2	70.2 ± 3.6	3.7 ± 0.7
43	0.17 ± 0.03	0.25 ± 0.03	30.9 ± 2.4	6.8 ± 1.6	3.9 ± 0.1	6.3 ± 0.8	8.9 ± 1.4
44	ND	0.49 ± 0.18	59.9 ± 3.4	0.6 ± 0.1	12.2 ± 0.1	15.6 ± 1.2	2.5 ± 0.4
45	3.16 ± 0.38	0.83 ± 0.15	127 ± 10	12.7 ± 2.5	15.2 ± 11.3	27.5 ± 2.6	0.06 ± 0.01
46	2.59 ± 0.42	0.77 ± 0.22	99.3 ± 8.6	12.3 ± 3.1	22.8 ± 1.8	30.9 ± 2.7	18.1 ± 4.6
47	ND	0.13 ± 0.02	29.9 ± 3.4	7.6 ± 1.3	2.4 ± 0.1	26.0 ± 1.3	1.7 ± 0.3
48	0.48 ± 0.11	0.25 ± 0.03	24.9 ± 1.5	30.6 ± 4.3	5.9 ± 0.1	16.6 ± 0.4	0.15 ± 0.03
49	1.52 ± 0.11	0.84 ± 0.21	66.1 ± 4.7	10.8 ± 0.6	18.4 ± 1.3	22.6 ± 1.6	6.1 ± 1.8
$\overline{X}$	1.14 ± 0.15	1.14 ± 0.19	70.9 ± 6.6	22.3 ± 2.1	20.0 ± 1.7	32.9 ± 2.2	9.1 ± 1.9

$\overline{X}$: Average concentration of determined metal ions; ND:Not determined

Avarage Cu content is 22.3 ppm for all macrofungi samples (Table 2). From Table 2, the highest Cu level was 92.5 ppm for the species *Flammulina velutipes*, which was collected from the Campus of the Univercity of Dicle. The lowest Cu level was 0.18 ppm for *Agrocybe aegarita*, which was collected from Pohsor River of Çermik district of Diyarbakır. In the wild mushrooms samples, the highest Cu content was 51 ppm for the species *Tricholoma tereum* (Tüzen et al, 1998). This result shows that the Cu content depends on the species of mushrooms and of the localite. The concentration of Cu in the soil that irrigated with the Tigris River water and the wheat wich growth in these soils are higher than in non-irrigated one (Gümgüm et al, 2001).

In Table 2, avarage Mn content is 20.0 ppm for all macrofungi samples. The highest Mn level was 147 ppm for the species *Amanita vaginata*, which was collected from the Campus of the Univercity of Dicle. The lowest Mn level was 2.2 ppm for *Agrocybe aegarita*, which was collected from Pohsor River of Çermik district (Table 2). The highest Mn content was 35.9 ppm the species *Laccaria laccata,* where as the lowest Mn content was 2.95 ppm for species *Boletus* (Tüzen et al, 1998). Accordingly, Mn contents found in our study were much highest than those of given in the literature. Avarage Zn content is 32.9 ppm for all macrofungi samples (Table 2). In Table 2, the highest Zn level was 154.3 ppm for the species *Flammulina velutipes*, which was collected from in the Campus of the

University of Dicle. The lowest Zn level was 0.2 ppm for *Agrocybe aegarita*, which was collected from Pohsor River of Çermik district. Zn is -due to its biological significiance- widespread among living organizms. The average Zn content in trestrial fungi is about 100 µg-1 d.w.which is little higher than that in most vascular plant tissues (Mejstric and Lepsova, 1993). In this case, Zn taken up from woody substrate may be an important part of the total Zn content in fungus (Gabriel et al, 1997). The concentration of Zn in the soil that irrigated with the Tigris River water and the wheat wich growth in these soils are higher than in non-irrigated one. (Gümgüm et al, 2001). In addition, the4 study shows that there is ahigh correlation between the amounts of Cu and Zn in the areas that irrigated by the Tigris River. That is when the amount of Cu is high, the amount of Zn is also high.

From Table 2, avarage Co content is 9.1 ppm for all macrofungi samples. The highest Co level was 36.3 ppm for the species *Coprinus micaceus*, which was collected from the Campus of the Univercity of Dicle (Table 2). The lowest Co level was 0,06 ppm for *Inocybe fastigiata*, which was collected from Sarım River of Lice district of Diyarbakır. The highest levels of Co (0.62 ppm) were determined for the species of *Amanita rubescens* (Sesli et Tüzen, 1999). Generally litle Co was found in the samples tested, however it varied between 0 and 2.75 (The latter was found in a *Clitocybe nebularis* sample) but no systematic correlation could be observed (Vetter, 1990). Accordingly, Co contents found in our study were much highest than those of given in the literature (Vetter, 1990; Sesli et Tüzen, 1999). This paper deals with the pollution effect of the Tigris River, in the typical areas of the river wich the southeast and the northwest of Diyarbakir province (Turkey). A direct relation has been found between the metal concentrations and the Tigris River water. Contaminantal water and soil may constitute a large potential health risk for both the surrounding ecosystems and the population and this may influence aquatie life and also constitute a great potential health hazard. It may be concluded that heavy metal contaminants are oriented from Ergani copper plant. The levels of the investigated metals in nearby the Tigris River samples are high, where as, they remain within an acceptable range in areas that are further away (Gümgüm et al, 2001). Consequently, the results of this study coincide with the results of the study of (Gümgüm et al, 2001).

Acknowledgments. Authors are grateful to the Turkish Scientific Research Grant Committee TÜBİTAK for financing this study [Project No: TBAG-2200 (102T098)]. The authors also wish to thank anonymous review for their valuable comments.

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