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Determination of Some Heavy Metal Levels in Muscle Tissues of Lake Van Fish (*Chalcalburnus tarichi*)

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Some heavy metal (Zn, Pb, Cd, Cr, Ni, Co, Bi, Mn, Cu) concentrations in the muscle tissues of Lake Van fish (*Chalcalburnus tarichi*) were measured and compared with sea fish. Metal concentration in muscles was investigated by linear regression analysis. Concentration (as μg/g dry weight) was highest for Zn (1.806 ± 0.553) and lowest for Cd (0.032 ± 0.014). Cu was not measured. The highest concentration of Zn (3.02), Pb (0.09), Cd (0.06), Cr (0.09), Ni (0.44), Co (0.26), Bi (0.64) and Mn (0.42) were measured in muscle tissues of Lake Van fish (*Chalcalburnus tarichi*).

Key Words: Trace metals, Lake Van Fish, Aquatic animals.

INTRODUCTION

All aquatic living creatures accumulate trace metals in their tissues, whether or not these metals are essential to metabolism. Different fishes accumulate trace metals to different concentrations in their tissues, organs and their bodies[1]. Thus, aquatic fishes living in the same habitat may well have very different body concentration of trace metals[2, 3]. Whether an accumulated trace metal concentration is high or low, therefore, cannot be assesed on an absolute scale, the significance of an accumulated concentration depending on the specific tissue and the specific creature involved[4–8]. Thus, an accumulated trace metal body concentration that is a typically high for one species may be considered very low for another.

Heavy metals like copper, zinc and iron are essential for fish metabolism while some others such as mercury, cadmium, lead and nickel have no known role in biological system. For the normal metabolism of fish, the essential metals must be taken up from water, food or sediment. However, similar to the route of essential metals, non-essential ones are also taken up by fish and accumulate in their tissues. The accumulation of heavy metals in a tissue is mainly dependent upon water concentration of metals and exposure period, although some other environmental factors such as salinity, alkalinity, pH, hardness and temperature play significant roles in metal accumulation[9].

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Lake Van is the largest soda lake and fourth largest closed lake on earth. It is situated at 1648 m above sea level in Eastern Anatolia, Turkey. It has many springs and freshwater river inlets to Lake Van. Salinity of Lake Van, which has conditions of extreme alkalinity (pH 9.8), is 0.19%. It is very suitable both in the feeding and living habitat for *Chalcalburnus tarichi* (pearl mullet; local name: van fish) that is an endemic species and is the only fish living in Lake Van[10, 11]. It is important to understand better the relationships between highly alkaline water and concentration of both essential and non-essential metals.

The aim of this study is to determine heavy metals (Zn, Pb, Cd, Cr, Ni, Co, Bi, Mn, Cu) levels in muscles of Lake Van fish (*Chalcalburnus tarichi*).

EXPERIMENTAL

Samples of Lake Van fish were collected from ten centres of Lake Van (in East Anatolia region of Turkey). All samples were washed in fresh running water to eliminate dust, dirt, possible parasites or their eggs and then were again washed with double-distilled water and muscles of fish were eliminated from other parts of fish. After this dissection the muscles were put into an oven to dry at 105°C. After the muscles reached constant weight in the oven, they were transferred into a porcelain mortar, ground and sieved (200 mesh). One gram of dry matter was weighed in a porcelain crucible, followed by addition of a 3 mL mixture of ethyl alcohol and sulphuric acid (95/5 v/v) and burned. After burning completed, it was ashed at 600–650°C (gradually increased) in a muffle furnace[12].

The ashes were dissolved with 5 mL 3 N HCl and the solution transferred to a 100 mL calibrated flask and diluted to 100 mL with double distilled water and after 5-6 h, filtered with blue-band filter paper and again regulated to 100 mL. Metal concentrations were measured using a Unicam 929 flame atomic absorption spectrometer and metal concentration in muscle was presented as μg/g dry weight (ppm).

Statistical analysis of the data was carried out using SPSS statistical package program. One-sample statistics T-test was applied to the data to compare the relationship between metal concentrations of Van Lake fish and standards.

RESULTS AND DISCUSSION

The results of the analyses in fish muscle tissue samples collected from the chosen ten sampling locations in Lake Van are shown in Table-1 and Figs. 1–3. The mean metal concentrations in muscle tissues of fish and their standard deviations are shown in Table-1. The mean concentrations of both essential and non-essential metals in fish muscle tissues at each sample centre showed great variations of statistical comparisons that the average metal concentrations in the muscle of fish were significant ($p < 0.05$). According to the one-sample statistics T-test, Zn, Cr and Mn levels were significantly lower ($p < 0.05$); Bi and Co levels were significantly higher ($p < 0.05$) than standard values of these elements (DORM 2 and Median International Standards); Pb, Cd and Ni were not significant.

TABLE-1
HEAVY METAL CONCENTRATIONS OF FISH MUSCLE TISSUES COLLECTED FROM LAKE VAN, (ppm).

Elements	Sample Centres										Mean ± SD*
	1	2	3	4	5	6	7	8	9	10	
Zn	1.12†	3.02	1.36	1.46	1.92	2.36	1.67	1.94	1.77	1.44	1.806 ± 0.553
Pb	0.04	0.04	0.07	0.07	0.09	0.09	0.03	0.02	0.05	0.04	0.054 ± 0.025
Cd	0.03	0.02	0.03	0.02	0.02	0.06	0.03	0.05	0.04	0.02	0.032 ± 0.014
Cr	0.08	0.03	0.06	0.02	0.08	0.09	0.07	0.04	0.03	0.06	0.056 ± 0.025
Ni	0.15	0.22	0.20	0.19	0.24	0.10	0.44	0.38	0.41	0.13	0.246 ± 0.121
Co	0.25	0.20	0.12	0.21	0.16	0.20	0.22	0.26	0.22	0.16	0.200 ± 0.043
Bi	0.45	0.34	0.41	0.21	0.32	0.38	0.45	0.64	0.32	0.32	0.384 ± 0.115
Mn	0.12	0.10	0.42	0.43	0.14	0.11	0.29	0.26	0.15	0.12	0.214 ± 0.128
Cu‡	—	—	—	—	—	—	—	—	—	—	—

* Standard deviation; † n = 3 for all samples; ‡ Non-detected

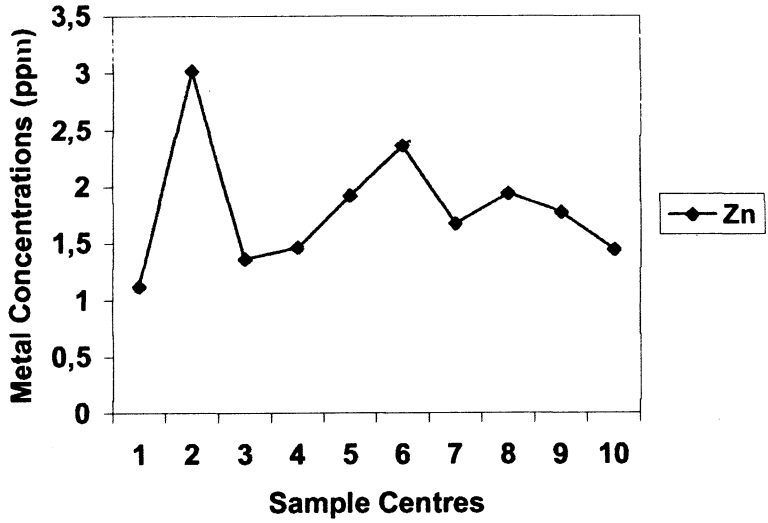

Fig. 1. The concentration of heavy metal in muscle of Lake Van fish (ppm).

It is well known that one of the most important factors that plays a significant role in heavy metal accumulation in marine animals is the metabolic activity[13]. High concentration of metals in water can retard fish development causing possible alteration in fish size[13–15]. Fish development can be affected by the presence of heavy metals in water and especially the early life stages such as hatching time, larval development and juvenile growth as they are more sensitive than the mature stages. Studies on fish development are generally carried out in

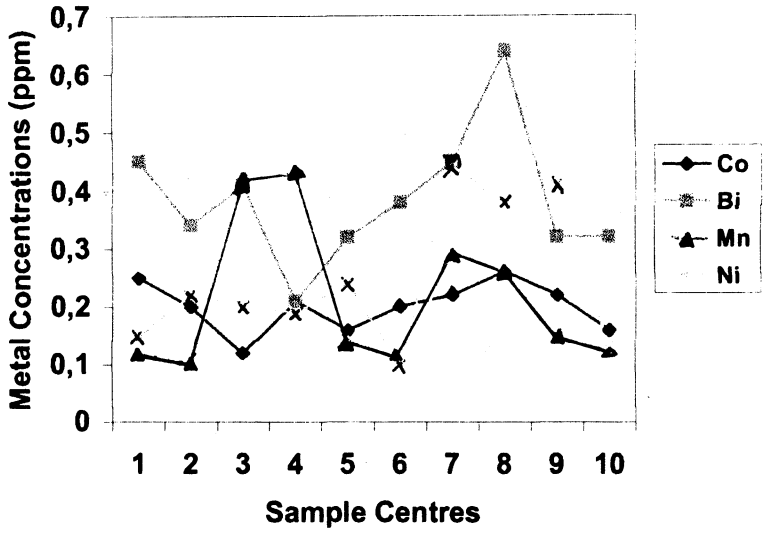

Fig. 2. The concentrations of some heavy metals in muscle of Lake Van fish (ppm).

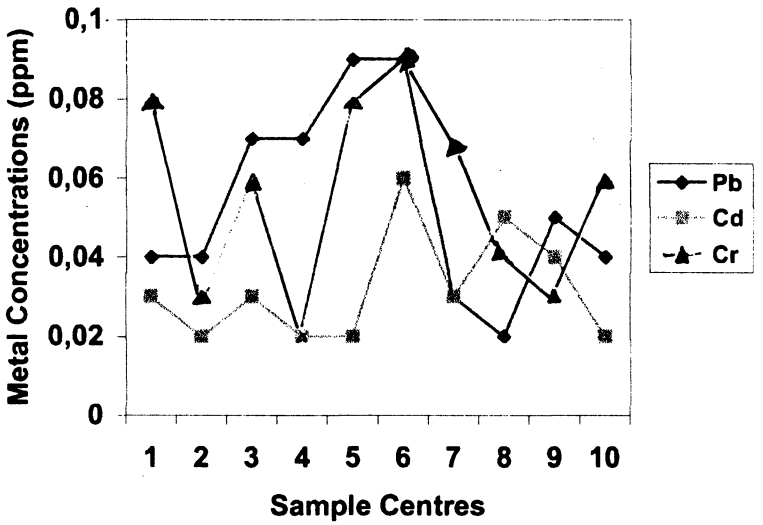

Fig. 3. The concentrations of some heavy metals in muscle of Lake Van fish (ppm).

laboratory conditions with excess levels of metal exposures. However, fish growth and its relationship with metal concentration in the aquatic environment should also be monitored occasionally in the field to better understand the effects of metals on fish development and the current situation of population dynamics[9]. The concentrations of metals in fish muscle tissues were calculated higher than the concentrations of metals in Lake Van water[16] and lower than the concentrations of metals in sea fish[9].

Thus, food chain transfer of trace metals can be significant for aquatic animals, but such transfer is controlled not just by the quantity of metal accumulated in the prey but also its physicochemical form, itself a result of the physiological detoxification process favoured by the prey species. Aquatic animals show a vast range of accumulated trace metal concentration, the reasons for which can be interpreted in terms of the particular accumulation patterns used by particular animals for particular trace metals. Accumulated metal concentrations in fish also have the potential to provide a great deal of information of applied relavance in terms of the geographical and temporal variation in the bioavailabilities of toxic metals in aquatic systems[17].

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